LAW LIBRARY
OF
LOS ANGELES COUNTY

1868

THE LIBRARY
OF
THE UNIVERSITY
OF CALIFORNIA
LOS ANGELES

SCHOOL OF LAW

ok is the Property
of the
COUNTY LAW LIBRARY

If found elsewhere than in
Law Library, please return,
or notify Librarian.

Books belonging to this
Library are never sold,
exchanged or given away.

WITHDRAWN
L. A. C. L. L.

CHICAGO STAR
BINDERY
224 S. Spring St., L. A.
Tel. MUtual 4434

LAW LIBRARY
OF
LOS ANGELES COUNTY

MEDICAL
JURISPRUDENCE
FORENSIC MEDICINE
AND
TOXICOLOGY

WITHDRAWN

BY

R. A. WITTHAUS, A.M., M.D.

Professor of Chemistry, Physics, and Toxicology in Cornell University

AND

TRACY C. BECKER, A.B., LL.B.

Counsellor at Law

Professor of Criminal Law and Medical Jurisprudence in the University of Buffalo

With the Collaboration of

August Becker, Esq.; A. L. Becker, Esq.; Chas. A. Boston, Esq.; Hon. Goodwin Brown; W. N. Bullard, M.D.; J. C. Cameron, M.D.; J. Clifton Edgar, M.D. Jas. Ewing, M.D.; E. D. Fisher, M.D.; J. C. Johnson, M.D.; D. S. Lamb, M.D.; H. P. Loomis, M.D.; W. B. Outten, M.D.; Roswell Park, M.D.; J. Parmenter, M.D.; Irving C. Rosse, M.D. E. V. Stoddard, M.D.; George Woolsey, M.D. J. H. Woodward, M.D.

Second Edition

VOLUME TWO

NEW YORK
WILLIAM WOOD & COMPANY
MDCCCCVII

Copyright, 1907
By WILLIAM WOOD AND COMPANY

PRESS OF
PUBLISHERS PRINTING COMPANY
419-421 LAFAYETTE ST.
NEW YORK

PAGE
Southwell *v.* Gray, 35 Misc. (N. Y.), 740 338
Stack *v.* New York, N. H. & H. R. R. Co., 177 Mass., 155 ......503, 504
Stanwix case, General (Rex *v.* Hay), 1 W. Bl., 640; 4 Burr., 1295. 338, 344
State *v.* Arden, 1 Bay. Rep. (S. C.), 487 500
State *v.* Arnold, 13 Ired. Law (35 N. C.), 184......................498
State *v.* Thomson, 155 Mo., 300..499
Stinde *v.* Ridgway, 5 How. Pr. (N. Y.), 301....................338
Stuart *v.* Havens, 17 Neb., 211..503

Taylor *v.* Diplock, 2 Phillimore, 261. 338, 340
Turquand *v.* Strand Union, 8 Dowl., 201........................503

Underwood *v.* Wing, 19 Beavan, 459; 4 DeG., M. & G., 633; s. c., under name of Wing *v.* Angrave, 8 H. of L., 183; 30 L. J. Ch., 65. 338, 339, 340
Union Pac. R. R. Co. *v.* Botsford, 141 U. S., 250..498, 501, 502, 503

Wainwright, *Re*, 1 Sw. & Tr., 257.338
Webster *v.* Birchmore, 13 Ves. Jr. (Eng. Ch.), 362..............341
Wentworth *v.* Wentworth, 71 Me., 72. 338
Wheeler, *Re*, 31 L. J. P. & M., 40. 338
White *v.* Milwaukee C. R. R. Co., 61 Wis., 536..................503
Willbor, Petitioner, *Re*, 20 R. I., 126. 338
Wing *v.* Angrave, 8 H. of L., 183; 30 L. J. Ch., 65; s. c., under name of Underwood *v.* Wing, 19 Beavan, 459; 4 DeG., M. & G., 633. 338, 339, 340
Wollaston *v.* Berkley, 2 Ch. Div., 213; 34 L. T., N. S., 171; 24 W. R., 360; 45 L. J. Ch., 772.....338

740170

FORENSIC MEDICINE.

THANATOLOGICAL.

THE

MEDICO-LEGAL CONSIDERATION

OF

WOUNDS,

INCLUDING

PUNCTURED AND INCISED WOUNDS, AND WOUNDS MADE BY BLUNT INSTRUMENTS OTHER THAN GUNSHOT WOUNDS.

BY

GEORGE WOOLSEY, A.B., M.D.,

*Professor of Anatomy and Clinical Surgery in the Cornell University Medical College;
Surgeon to Bellevue Hospital; Associate Surgeon to the Presbyterian
Hospital; Fellow of the American Surgical Association and of the New
York Academy of Medicine; Member Medical Society of the County
of New York, New York Surgical Society, etc., etc.*

WOUNDS.

GENERAL CONSIDERATIONS. THE DIFFERENT KINDS OF WOUNDS.

THE surgical and medico-legal ideas of wounds are quite different, the latter including the former as well as other varieties of injuries.

Definitions.—Surgically a *wound* means a solution of continuity and refers to every such lesion produced by external violence or developing spontaneously. The medico-legal acceptation of the term is much broader and includes any injury or lesion caused by mechanical or chemical means. Vibert[1] quotes Foderé as defining a wound medico-legally as, "Every lesion of the human body by a violent cause of which the results are, singly or combined, concussion, contusion, puncture, incision, tear, burn, twist, fracture, luxation, etc.; whether the cause is directed against the body or the body against the cause." The same author quotes another definition of a wound as, "Every lesion however slight, resulting in concerning or affecting the body or health of an individual." Taylor[2] defines a wound in a medico-legal sense as "a breach of continuity in the structures of the body whether external or internal, suddenly occasioned by mechanical violence." Thus, the term wound in its medico-legal acceptation includes not only surgical wounds but contusions, fractures, burns, concussion, etc. In France at least the voluntary inoculation of syphilis has been considered as coming under the category of wounds.[3]

Medico-legally, the severity of a wound is much more important than the kind of wound. Thus we may consider wounds according to their comparative gravity, as mortal, severe, or slight.

---

[1] "Précis de Méd. Lég.," 2d Ed., 1890.

[2] "Med. Jurisprud.," 11th Amer Ed., 1892.

[3] Arrêt du tribunal de Lyon, 8 et 15 décembre, 1859.

A *mortal* wound is one which is directly fatal to life in a comparatively short time, usually from hemorrhage, shock, or the injury of a vital part. A wound may result fatally without being a mortal wound, as when a slight wound causes death on account of some wound infection.

Severe wounds, or "wounds causing grievous bodily harm," as they have long been called, do not put life in imminent danger, though they may be inconvenient or detrimental to health. Pollock, C. B., says that a wound causing grievous bodily harm is "any wound requiring treatment."

A medical opinion or certificate may be required as to the danger of a given wound, and on this opinion may depend the question of bail for the prisoner. By the danger of a wound in such a case is usually meant imminent danger, as any wound may be remotely dangerous to life.

Slight wounds, as already stated, may result fatally under certain conditions. Under the French practice a slight wound is one which does not incapacitate one from work for more than twenty days. Looked at in another way, slight or severe wounds may be classified according as they are completely curable, leaving no infirmity or disturbance of function, or not completely curable. The latter are such as are necessarily followed by permanent or temporary infirmity.

The question as to the severity of any given wound may sometimes be left to the jury to decide from the description of the wound, or a medical opinion may be required.

Although the intent of the assailant is often of equal or greater importance than the severity or kind of wound, yet this can only occasionally be inferred from the surgical aspects of the wound.

The classes of wounds to be treated in the following pages are incised and punctured wounds and wounds with blunt instruments, some of the characteristics of which we will now consider.

Incised wounds are such as are produced by a cutting instrument, and they are distinguished by the following characteristics: They measure more in length than in the other dimensions. They are usually straight in *direction*, though not infrequently curved, and they may even be zig-zag, especially where the skin lies in folds. The *edges* of an incised wound are linear, and show no signs of contusion. They are either inverted or everted and the edges and sides of the wound are retracted. The eversion of the skin is due to its elasticity, but in some regions of the body, *e.g.*, in the scrotum, etc., the skin is inverted owing to the contraction of the muscle fibres immediately beneath. The gaping of the wound is due to the retraction of the divided muscles and fibrous structures. It varies according as the muscles are cut directly across or more lengthwise, and in proportion to the distance of the wound from the points of attachment of the muscles.

The fibrous tissues, fasciæ, and aponeuroses retract less, and so give a somewhat irregular surface to a large wound.

Ogston[1] divides incised wounds into three parts, the commencement, centre, and end, of which the end often has two or more serrations differing from the commencement, which has but a single point. There are often one or more slight, superficial, tentative incisions situated almost always, though not invariably, near the commencement.[2] The deepest part of the wound is more often near the commencement. If there are angular flaps on the edges their free angles point to the commencement of the wound.

Coagula and clots of blood are to be found in the wound, more or less filling it up if it has not been interfered with. On examination the ends of the divided vessels are found plugged with clots which may protrude somewhat from their openings.

If the wound is seen very shortly after its infliction, hemorrhage is in progress, and the divided arteries show their position by their individual, intermittent jets of blood. The severity of incised wounds depends upon the amount of hemorrhage, which is greater the deeper and larger the wound, and the more vascular the tissues in which it occurs, especially if large and important vessels are concerned. In the latter case an incised wound may be very rapidly fatal. Incised wounds present the least favorable conditions for the spontaneous arrest of hemorrhage of any form of wounds.

The edges of an incised wound may be quite rough and even dentated or lacerated if the edge of the weapon be rough and irregular.

The kind and condition of a weapon which has produced a given incised wound may often be learned by an examination of the characteristics of the wound.

---

[1] "Lectures on Med. Jurisprud.," 1878, pp. 422, 423.

[2] See Figs. 10 and 11.

Weapons cutting by their weight as well as by the sharpness of their edges, such as axes, etc., may cause a certain amount of contusion about a wound; they crush the soft parts to a certain extent, and the bones may be indented or even fractured.

Wounds caused by fragments of bottles, pieces of china, earthenware, or glass, though strictly speaking incised wounds, are often curved, angular, and irregular, and their edges jagged and contused.

Wounds caused by scissors may sometimes be of the nature of incised wounds. When they present a double wound of triangular shape, with the apex of the triangle blunt, they are more of the nature of punctured wounds. In general a "tail" or long angle in the skin at one end of an incised wound indicates the end of the wound last inflicted, and some light may thus be thrown upon the inflicter of the wound.

Incised wounds present very favorable conditions for healing by primary union, but often fail in this and heal by secondary union. When an incised wound fails to unite by primary union, bleeding continues for several hours or even as long as a day, the blood being mixed more or less with a serous discharge. The latter continues until the third day or so. By the fourth or fifth day the surface has begun to granulate, and there may be a more or less profuse purulent discharge from the surface. The granulating surfaces do not necessarily discharge pus, however. For some days, therefore, after the infliction of an incised wound, or until the surface is covered with granulations, the characteristics of the wound permit of a diagnosis as to the nature of the wound.

The *diagnosis* of an incised wound is generally without difficulty. Some wounds by blunt instruments, however, in certain regions of the body, resemble incised wounds very closely. Such instances are found where a firm, thin layer of skin and subjacent tissue lies directly over a bony surface or a sharp ridge of bone. These are seen most often in the scalp or in wounds of the eyebrow where the sharp supra-orbital ridge cuts through the skin from beneath. The diagnosis of an incised wound can often be made with great probability from the cicatrix. This is especially the case if the wound has healed by primary union and the cicatrix is linear.

The *prognosis* in incised wounds is good as to life unless a large vessel has been divided or unless an important cavity or viscus has been penetrated. The prognosis as to function varies with the position and extent of the wound, and the circumstance of the healing of the wound.

Punctured Wounds, Stabs, etc.—These are characterized by narrowness as compared to depth, though the depth is not necessarily great. They are more varied in character than incised wounds owing to the great variety of form of the weapons by which they may be made. From the form, etc., of a particular wound we may often infer the variety of weapon by which it was produced. According to the weapon used, punctured wounds have been divided into several classes, of which M. Tourdes distinguishes four: 1st. *Punctured wounds by cylindrical or conical instruments* like a needle. If the instrument be very fine like a fine needle, it penetrates by separating the anatomical elements of the skin, etc., without leaving a bloody tract. Such wounds are generally inoffensive, even when penetrating, if the needle is aseptic, and they are difficult to appreciate. On the cadaver it is almost impossible to find the tract of such a wound. If the instrument be a little larger it leaves a bloody tract, but it is difficult to follow this in soft tissues, more easy in more resistant structures, such as tendon, aponeurosis, cartilage, or serous membrane.

If the instrument be of any size this variety of punctured wounds presents a form quite different from that of the weapon. Instead of a round wound it is generally a longitudinal wound with two very acute angles and two elongated borders of equal length, showing but little retraction. This is the shape of the wound even when the instrument producing it is so large that the resulting wound resembles that made by a knife (see Fig. 2). The direction of the long axis of these wounds varies in different parts of the body and is uniform in the same part. Their shape and direction are explained by the tension of the skin or still more clearly by the direction of the fibres of the skin, just as with the same round instrument in a piece of wood a longitudinal opening or split would be made parallel to the grain (see Fig. 1). In some regions, as near the vertebræ, the fibres may run in different directions, and the resulting wound is stellate or triangular in shape as if a many-sided instrument had caused it. As the direction of the fibres of the various tissue layers, such as aponeuroses, muscles, serous and mucous membranes, etc., may be different, a deep wound involving several such layers would have a different direction for each layer. In illustration of this, examine the figure of a wound through the wall of the stomach (see Fig. 3).

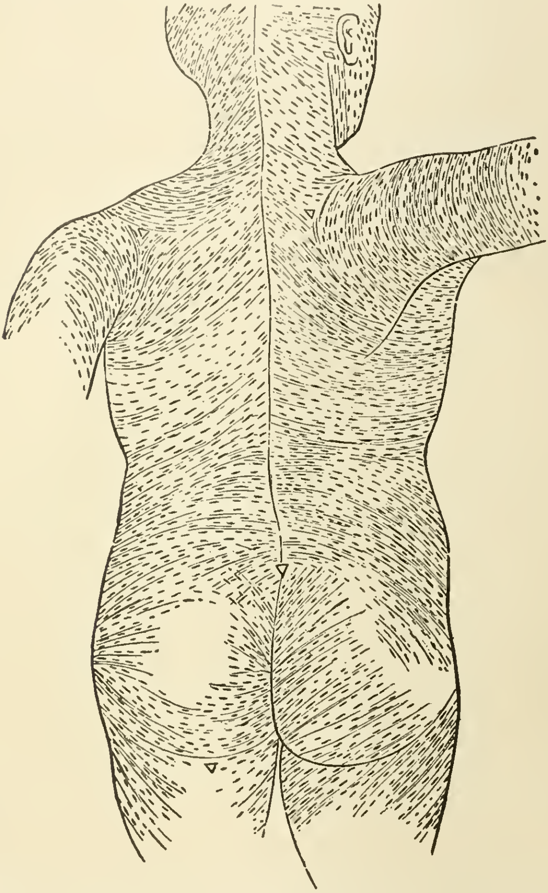


FIG. 1.—Direction of the Long Axis of Wounds of the Back caused by Conical Instruments. (After Langer.)

The wounds above described when large are smaller than the weapon, as the splitting of the skin has certain limits and also owing to the elasticity of the skin, which is put on the stretch by the weapon and relaxed on its withdrawal. When such wounds are small they are larger as a rule than the instrument causing them.

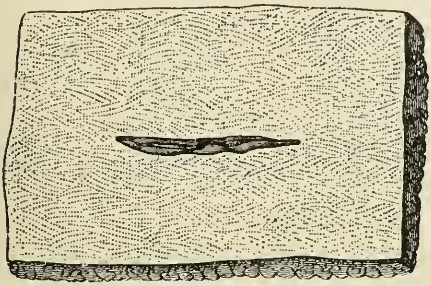


FIG. 2.—Slit-like Wound caused by a Pointed Conical Instrument 2.5 cm. in Diameter. Natural size.

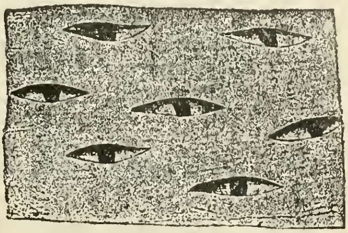


FIG. 3.—Wounds of Stomach Wall by a Conical Instrument, showing the Different Direction of the Long Axis of the Wounds in Different Layers.

2d. *Punctured wounds by instruments both sharp-pointed and cutting*, like a knife or dagger. If these wounds are perpendicular to the surface, they have more or less the form of the weapon used. The angles may show whether the knife, etc., had one or two cutting edges, but even though the back of the knife is broad the wound may resemble one caused by a double-edged weapon. Thus stab-wounds from a common pocket-knife show only exceptionally a wedge-shape, but regularly a slit, the edges of which are slightly curved to one another and end in two acute angles. The reason of this lies in the fact that the wound is only caused by the cutting edge of the knife, so that we cannot tell as a rule which angle was occupied by the back of such a knife (Figs. 4 and 5). The depth of these wounds may equal the length of the weapon or be almost any degree less, but the depth may

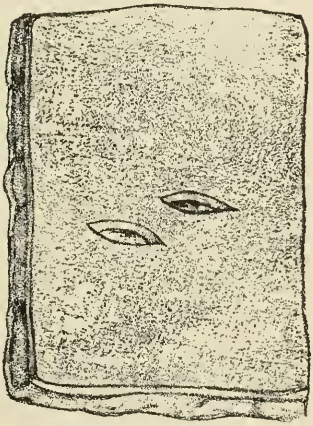


FIG. 4.—Stab-Wound of the Skin with a Knife a Few Minutes before Death.

even be greater than the length of the weapon by reason of a depression of the parts at the time of the blow. The wound is often shorter and broader than the weapon causing it, though more often it is larger than the weapon from the obliquity of the wound and the movement of the weapon on being withdrawn. The wound is smaller than the instrument where the parts are on the stretch at the time the wound is inflicted.

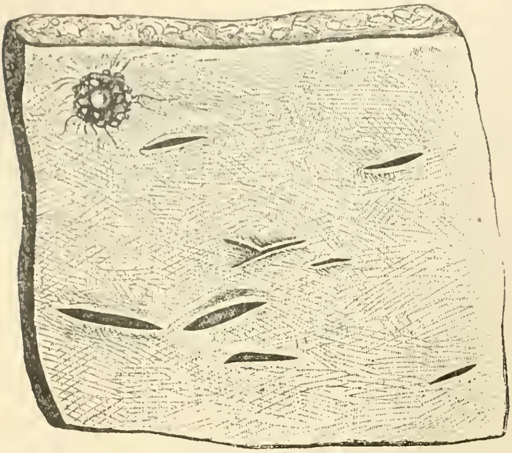


Fig. 5.—Nine Suicidal Stab-Wounds in the Region of the Heart made by a Knife used for Cutting Rubber.

This variety of punctured wounds may resemble the former class in the direction of its long axis, if the cutting edge of the instrument is blunt. The regularity and smoothness of the edges distinguish them from certain contused wounds.

3d. *Wounds made by instruments with ridges or edges*, files, foils, etc. If the edges are cutting the wound presents more or less the shape of the weapon (Fig. 6). But this is not always so, probably from the instrument puncturing obliquely or from the tissues being unequally stretched (Fig.7). If the edges are not cutting the wound resembles those of the first class, though the edge often presents little tears, and the wound may thus be more or less elliptical with two unequal angles. The wound of entrance and exit may be different.

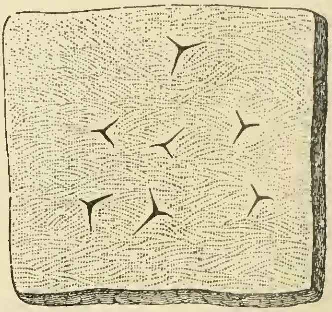


Fig. 6.—Stab-Wounds caused by a Three-Sided Sharp-Edged Pointed Instrument.

4th. *Irregular perforating instruments*, the wounds from which resemble contused wounds.

Contusions and Contused Wounds.—A contusion is a wound of living tissues by a blow of a hard body, not sharp-edged or pointed, or by a fall, crushing, or compression, and without solution of continuity of the skin. A contusion usually involves a moderately large surface in comparison to the two other classes of wounds. Contusions are of all degrees of severity. If the blow or injury is slight, there is only slight redness and swelling of the skin with pain, disappearing in a few hours, and leaving no traces. If the blow be harder it produces more or less crushing of the tissues, accompanied by ecchymosis with or without a wound or excoriations of the skin, etc. The contusion may have the shape of the contusing body, such as a whip, the fingers, etc.

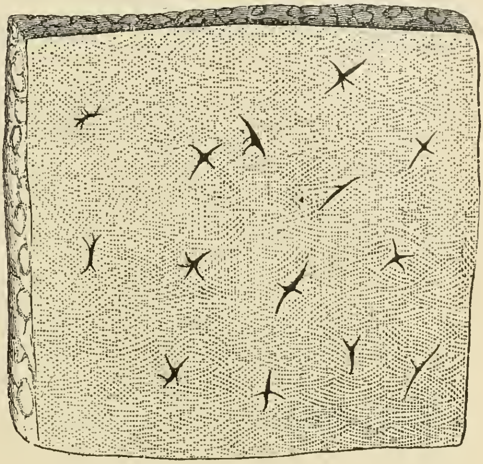


Fig. 7.—Stab-Wounds caused by an Eight-Sided Sharp-Edged Instrument. Some show a transition stage to wounds made by a conical instrument.

Ecchymosis.—This is characteristic, as a rule, of contused wounds. It consists in the infiltration of blood into the tissues, especially the cellular tissues. The source of the blood is from the rupture of blood-vessels, and the *size* of the ecchymosis varies partly with the number and size of the blood-vessels, or with the vascularity of the part. The size of the ecchymosis also varies with the looseness of the tissues into which it is infiltrated. This looseness of the tissues may be natural as in the scrotum and eyelids, or it may be due to the attrition of the tissues caused by the blow. An ecchymosis is larger when the contused parts cover a bony or resisting surface, and there may be no ecchymosis whatever, even from a severe blow, where the underlying parts are soft and yielding, as is the case with the abdominal parietes. Here we may have rupture of the viscera without any signs of ecchymosis superficially. An ecchymosis may be infiltrative or it may mostly occupy a cavity, usually formed by a traumatic separation of the tissues; this is especially the case in the scalp and extremities when the injury is severe. These tumors, which are called *hematomata*, may be rapidly absorbed or they may remain a long time and occasionally suppurate. Sometimes the anatomical conditions, especially of the connective-tissue spaces, allow the extension or migration of the ecchymosis under the action of gravity, even to a considerable distance. When it meets an obstacle it accumulates above it, as in the inguinal region for abdominal ecchymosis and at the knee for those of the thigh. The course along which the ecchymosis travels is indicated externally by a yellowish stain, soon disappearing, so that soon no sign persists at the site of injury, but only below where the blood is arrested.

An ecchymosis becomes visible at varying times after the injury according to the depth of the ecchymosis and the thinness of the skin, for the ecchymosis is mostly beneath, not in the skin. If the ecchymosis is superficial it shows in one or two hours or even in less time where the skin is very thin, as in the eyelids and scrotum. In such cases it increases for thirty or forty hours and disappears in a week, but may last longer, *i.e.*, as long as fifteen to twenty-five days.

An ecchymosis may not show at the point struck, at least not until several days have elapsed, or it may only show on the under surface of the subcutaneous fat until it has imbibed its way, as it were, to the surface. This may explain the discrepancy in the description of an injury examined by two medical experts at different times.

If an ecchymosis is extensive and deep, especially if it occupies a cavity, there may be nothing to see in the skin for four or five days, and then often only a yellowish discoloration instead of a dark blue color. In such cases, too, the appearance in the skin may be more or less remote from the injury, having followed the course of the least anatomical resistance. Between these two extremes, an ecchymosis may become visible at almost any time. Rarely an ecchymosis occurs only deeply between muscles (pectorals, etc.) and not superficially at all.

The extravasation of blood which forms an ecchymosis has sometimes been given different names, according to its extent or position, for instance, parenchymatous or interstitial hemorrhages or apoplexies, suffusions, ecchymoses, petechiæ or vibices.

All such may, however, be called ecchymoses or hematomata. When blood is effused into the serous cavities of the body, special names are sometimes applied according to the position, such as hemothorax, hematocele, etc.

The color of an ecchymosis is at first a blue-black, brown, or livid red. This color changes first on the edges, later in the darker centre, and becomes in time violet, greenish, yellow, and then fades entirely. This change in color is owing to a gradual decomposition of the hæmoglobin of the blood. We can tell the age of an ecchymosis from its coloration only within rather wide limits, for the rapidity of change of color varies widely according to a large number of circumstances, especially according to whether the ecchymosis is superficial or deep. We can only say that the first change, *i.e.*, that to violet, in a superficial ecchymosis, occurs in two or three days.

As an exception to the above color change, we may mention sub-conjunctival ecchymosis, which always remains a bright red, as the conjunctiva is so thin and superficial that the coloring matter of the blood is constantly oxidized.

The form of an ecchymosis often reproduces well enough that of the instrument, except if the latter be large it cannot all be equally applied to the surface, and its form is not distinctly shown by that of the ecchymosis. After its first appearance an ecchymosis spreads radially, the edges becoming less clear. This change occurs more rapidly the looser the surrounding tissues, and at the end of a few days the first form of an ecchymosis may be changed, so that an examination to determine the nature of the weapon should be made as early as possible.

Ecchymoses are more easily produced in the young, the aged, and in females, also in the case of such general diseases as scurvy, purpura, hemophilia, etc. In fact, in the last three classes they may occur spontaneously. This fact should never be lost sight of, as the attempt may be made to explain a traumatic ecchymosis in this way. The diagnosis between the traumatic variety and such cases of spontaneous ecchymoses is, in general, easy, for in the latter case their number, form, size, and occurrence on parts little exposed to injury and on the mucous membranes, as well as the general symptoms of the disease, leave little or no room for doubt.

From an oblique or glancing blow a considerable area of skin may be stripped up from its deep attachments forming a cavity which may be filled by a clear serous fluid alone, or with some admixture of blood. These cases have been studied especially by Morel Lavallée and Leser, and the fluid has been thought to be lymphatic in origin, hence the name "*lymphorrhagia.*" Carriage accidents, especially where the wheels do not pass directly but obliquely across or merely graze the body, are especially liable to show this form of extravasation, which is thought to be more common than is generally supposed, being often obscured by a small quantity of blood.

Contused Wounds.—If with the contusion we have a solution of continuity of the skin, then we have a contused wound. This may sometimes resemble an incised wound if the weapon has marked angles or edges, as a hammer, or, as we have already seen, in wounds of the scalp or eyebrow (Fig. 8). Careful examination, however, by a small lens if necessary, is sufficient to distinguish them if they are fresh. If they are four or five days old and have begun to granulate, it may be impossible to distinguish them. Contused wounds present on examination small tears on the edges, and the latter are widely separated and more or less extensively ecchymosed. Contused wounds are often irregular, and have thickened or swollen and ragged borders. They may, like simple contusions, show by their shape the form of the instrument which caused them. In contused wounds, unless they be perfectly aseptic, we usually find sloughing of the contused, necrotic tissues. This leaves a cavity to be filled up by granu-

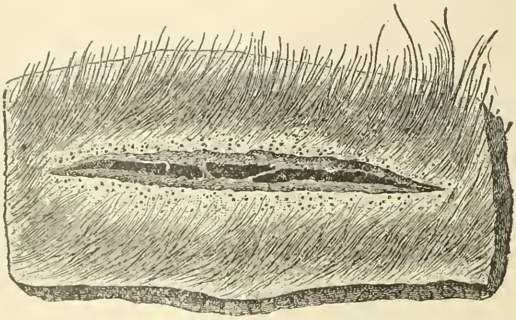


FIG. 8.—Linear Wound with Nearly Clean-Cut Edges, with Strands of Tissue bridging across at the Bottom and caused by a Fall on the Head on a Smooth Surface.

lation like wounds with loss of substance. They therefore often present large cicatrices which may be mistaken for those of ulcers. In contused wounds the bone may sometimes show the impression of the instrument causing the wound.

A variety of contused wounds is that where the wound of the skin consists merely of an *erosion* or *excoriation* with an ecchymosis beneath. The wound may reproduce the shape of the weapon, *i.e.*, finger-nails, etc. After death the skin becomes brownish-yellow, hard, and dry, and then they are called by the French "*plaques parcheminées.*" They are distinguished, as a rule, from those produced after death, by the ecchymosis beneath.

Lacerated wounds resemble contused wounds very closely, but are not ecchymosed to any considerable extent. The solution of continuity is sometimes very extensive and irregular, and may present several flaps. The bone or bones are often fractured at the same time. They seldom bleed much. The course of repair resembles that of contused wounds as a rule. The prognosis is variable, for there may be slow and extensive cicatrization and impairment of function, etc. These wounds usually result from machinery accidents and accidental tears, etc. They are therefore seldom the occasion of criminal proceedings but more often of a civil suit, and thus require medical examination.

The injury which causes a contusion or contused wound may not infrequently produce effects far more serious than and more or less remote from the contusion. Some of these effects it may be well to particularize. Blows on the abdomen are sometimes quickly followed by death without visible lesion to account for it. That authentic examples of this exist has been denied by Lutaud, except for cases of rapid death following contusions of the abdomen which had caused extensive rupture of the viscera and abundant hemorrhage. But Vibert gives two cases from his own experience, which are as follows:

A young man, twenty years old, received a kick in the stomach at a public ball. Numerous witnesses of the scene testified that he only received this one blow. The man collapsed immediately and died in a few minutes. On autopsy nothing was found but two small ecchymotic spots in the peritoneum covering the intestine, the largest not the size of a bean.

In the second case, the injury was also a kick in the stomach and the man died almost immediately. Absolutely no lesion was found on autopsy. Both were in full digestion.

König[1] says: "A number of severe contusions of the belly run a rapidly fatal course without the autopsy showing any definite anatomical lesion of the viscera." He also adds that the less severe cases often show very profound shock at first, which is out of proportion to the force of the injury and is due to a reflex paralysis of the vasomotor centres in the medulla. The cause of death has been explained, like that of sudden death from a blow on the larynx, by the theory of cardiac inhibition. These cases are often illustrated experimentally on frogs, where the same result is obtained under similar conditions. Such cases are the more remarkable from the fact that the fatal blow may cause no ecchymosis or other mark of injury to appear on the abdominal walls. The fact is now pretty well established that in most cases of abdominal contusion accompanied by profound shock or rapidly followed by death there is visceral rupture with severe hemorrhage. But the latter conditions may be present when there is but little shock.

Blows on the head may produce a variety of results besides that of the contusion itself. In fact, death itself may result though the marks of contusion are very slight or even imperceptible. Intracranial hemorrhage, laceration with ecchymosis of the brain, on the same or opposite side to the injury, and concussion of the brain may result. Of these only concussion will be considered now.

Concussion has been defined as a shock communicated to an organ by a blow or fall on another part of the body, which may or may not be remote, and without producing a material or appreciable lesion. According to Lutaud,[2] English pathologists understand by it a temporary or permanent nervous exhaustion resulting from a sudden or excessive expense of nervous energy. Its effect is observed in the function of an organ and especially in the brain. Concussion of the brain causes stupidity, loss of consciousness, amnesia, coma. The intracranial lesion most often associated with concussion is ecchymosis and laceration on the surface of the brain, but there may be no lesion visible even if the case is a fatal one. Fatal concussion has been observed where the marks of external violence were very slight or even failed entirely, as illustrated by the two following cases cited by Vibert:[1]

---

[1] "Lehrbuch der Speciellen Chirurgie."

[2] "Manuel de Lég.," 5th Ed., 1892.

Vibert made an autopsy on a man who had been struck by a pitchfork, one of the teeth of which struck behind the ear, the other two in the face, only producing slight skin wounds. The man immediately lost consciousness and died in two days in coma. No lesion whatever was found within the skull, and only three slight ones externally.

He observed another case where the man fell three or four metres into an excavation, landing on his feet, and died in a short time. On autopsy only slight erosions and no intracranial or extracranial lesions were found.

This case belongs to a rare class where the blow is transmitted through the spinal column without sign of injury externally or internally to the head.

The following case cited by Vibert is even more remarkable in the production of severe though not fatal concussion: An officer was riding at full speed on horseback, when his horse suddenly stopped short. By great exertion the officer clung to the horse, but immediately lost consciousness. His fall from the horse was broken by those about him, and the concussion he received was not due to the fall, but to the shock of stopping suddenly when his momentum was great.

As a rule, however, the diagnosis of concussion, especially if it is severe enough to be fatal, is easily made by the marks of external violence with or without intracranial lesions. The effects of concussion may be transient and leave no trace, but, on the other hand, they may be prolonged and severe, *i.e.*, paralysis, aphasia, loss of memory, imbecility, etc. The medical examiner should be on his guard against simulation in respect to these prolonged effects of concussions. One of the most frequent consequences of concussion is temporary amnesia, which ordinarily succeeds immediately after the injury, but sometimes develops more slowly. The following curious case is quoted from Lutaud as cited by Brouardel:

A woman in getting out of a train at Versailles, where she had gone to attend the funeral of a relative, was struck by the door of the compartment. She fell, but did not lose consciousness, and picked herself up, but forgot what she had come for.

---

[1] "Précis de Méd. Lég.," 2d Ed., 1890.

Another result of an injury which has caused a contusion or contused wound may be a fracture or dislocation. Fractures and dislocations of special parts will be referred to later, in considering injuries of the several regions of the body, but it seems appropriate here to refer to some of those general considerations relating to these injuries which may especially demand the attention of the medical expert.

Fractures may be produced by blows or falls, or from muscular action. The medical witness may be questioned as to the cause of the fracture or, if it was produced by a blow, whether a weapon was used or not, as the defence is likely to assert that it was caused by an accidental fall. The nature of the associated wounds and contusions, if any exist, may, as we have seen, indicate the weapon used. If anything exists to indicate that a fall which caused the fracture was not accidental, this should be noted, as the assailant is responsible for the effects of the fall.

A number of conditions influence the ease with which a fracture is produced and account for a fracture being due to a slight injury, and so are mitigatory circumstances in the case.

Fractures are more easily produced in the old and young, especially the former, than in the adult from the same force. This is due to brittleness of the bones in the old and their small size in the young. Certain diseases like syphilis, arthritis, scurvy, carcinoma, and rickets make the bones more frangible, and there is a peculiar brittle condition of the bones known as *fragilitas ossium*, more or less hereditary, in which the bones become fractured from very slight violence. Mercer is quoted by Taylor as stating, but on how good authority it does not appear, that in general paralysis of the insane the bones are particularly liable to fracture. Certain it is that not uncommonly insane patients are found dead with single or multiple fractures, but the attendants are generally convicted.

In some parts, like the orbital plate of the frontal bone, the bone is very thin and brittle, but brittleness from any cause only mitigates, it does not excuse.

Taylor[1] reports a case in point where it was proved that the bones of the skull were thin and brittle, and the fractured skull proved fatal from inflammation of the brain. The punishment was mitigated owing to the circumstance of the brittleness of the bones.

---

[1] Taylor: "Medical Jurisprudence," 11th American Edition (1892).

Spontaneous fractures may occur from only a moderate degree of muscular action, and even where there is no disease of the bones, but the above-mentioned condition of fragilitas ossium, rendering the bones more brittle, aids in the production of such fractures. The olecranon, patella, and os calcis are particularly liable to such fractures, but the long bones of the ribs and extremities are sometimes so fractured, as instanced in the following cases cited by Taylor:[1]

The humerus of a healthy man has been broken by muscular exertion simply by throwing a cricket ball.[2] In 1858 a gentleman forty years old, during the act of bowling at cricket, heard a distinct crack like the breaking of a piece of wood. He fell immediately to the ground, and it was found that his femur was fractured.

Again, in 1846, a healthy man, æt. 33, was brought to Gray's Hospital with the following history: He was in the act of crossing one leg over the other to look at the sole of his foot, when something was heard to give way; his right leg hung down and he was found to have received a transverse fracture of the femur at the junction of the middle and lower thirds.

The writer had a case in Bellevue Hospital during the winter of 1892–93 of a man who stated that he had been well and active until some weeks previously, when, from muscular force alone, he sustained a fracture of the neck of the femur. Something abnormal in the bone may be present in such cases.

In cases of spontaneous fractures there are no marks of external violence which, if present, would remove the idea of spontaneity.

Fractures of the extremities are not dangerous *per se*, unless they are compound or occur in old, debilitated, or diseased persons, and they are more severe the nearer they are to a joint. The healing of fractures is more rapid in the young than in the old and in the upper than in the lower extremity. It is not proven that adiposity of itself impedes union.

The question may be asked, how long before examination a given bone was fractured. As a rule, we can only say as to whether the injured person has lived a long or short period since the injury, as the process of repair varies according to age and constitution. No changes occur until eighteen to twenty-four hours, when lymph is exuded. According to Villermé the callus is cartilaginous anywhere between the sixteenth and twenty-fifth days, it becomes ossified between three weeks and three months, and it takes six to eight months to become like normal bone.

---

[1] Taylor: "Medical Jurisprudence," 11th American Edition (1892).

[2] London Med. Gaz., vol. xvi., p. 596.

The question may also be asked: Has a bone ever been fractured? The existence and situation of a fracture can often be recognized long after the accident, by the callus or slight unevenness due to the projection of the edges or ends of the fragments. Where the bone lies deeply covered by soft parts, it is difficult and often impossible to tell, long after union has taken place, whether or where a fracture has occurred.

The answering of this question may sometimes be of importance in identifying the dead, especially in the case of skeletons. In the latter instance by sawing the bone longitudinally we can tell by the thickness, irregularity, or structure of the bone tissue whether a fracture existed, and if it were recent or old at the time of death.

Dislocations call for a medico-legal investigation less often than fractures. They are less common in the old and where the bones are brittle, when fracture occurs more readily. They are seldom fatal *per se*, unless between the vertebræ or when compound. They may occur from disease in the affected joint or even spontaneously. The diagnosis of a dislocation is easy until it has been reduced, and then it may leave no trace except pain in and limitation of the motion of a joint besides swelling and ecchymosis. These effects are transient, and after they have disappeared it may be impossible to say whether a dislocation has existed on a living body, unless, as sometimes occurs, especially in the shoulder joint, there may be a temporary or permanent paralysis of a nerve and muscular atrophy. After death, the existence of an old dislocation may often be recognized on dissection by scar tissue in and about the capsule.

EXAMINATION AND DESCRIPTION.

The examination of wounds or injuries in a case which is or may become the subject of a medico-legal investigation should be made with particular care and exactness.

As the examination of the wounded person is to give most, and in some cases all, of the information to the medical expert on which he is to base his testimony, it should be made with reference to all the possibilities of the case.

The particular variety of wound as described in the foregoing section should be noted, and any peculiarities as to its situation, shape, extent, length, breadth, depth, direction, and the parts involved. Besides these points, the condition of the edges of the wound, whether swollen and ecchymotic, smooth and straight or dentated and irregular, and whether inverted or everted and gaping, are matters of importance. The presence or absence of coagula and clots, the staining of the tissues with blood, the presence of ecchymosis and its comparative age, as shown by its color, should also be noted.

Many of the above points help us in solving another problem, namely, the form of the instrument used. This question will be discussed in a subsequent section, but the basis for our opinion is founded, of course, on an examination of the particulars of the wound. The solution of still another question which often arises and which will be discussed in the next section, namely, whether a wound was produced before or after death, is based upon particular features of the wound such as the fluid or clotted condition of the blood on the surface, or ecchymosed in the tissues, also the amount of the hemorrhage as compared to the vascularity of the part as well as the greater or less staining of the tissues with blood, and the conditions of the edges, whether inverted or everted and whether or not retracted. The question as to whether a wound was directly, secondary or necessarily the cause of death, is determined, in part at least, by examination of the wound. In this connection we take note as to whether a wound has opened or divided a large vein or artery or is situated in such a vascular part as to be fatal from hemorrhage. We also note whether death could have been due to shock from the situation of the wound, or whether an inflammation which was directly responsible for death was necessarily due to the wound, as in case of a penetrating wound of the viscera, etc. Further, we note whether one of the many forms of wound diseases from infection of the wound has complicated the case and caused death in the case of a wound not otherwise necessarily fatal. It may be added that often the necropsy aids us in the solution of the question as to whether the wound was the necessary and direct cause of death, by showing a healthy or diseased condition of the viscera.

The question as to which of a number of injuries was first inflicted, also as to the relative position of the victim and assailant, can be answered, if at all, only by an accurate and close examination of the wounds.

Finally, the most important question of all, from a medicolegal standpoint, namely, the distinction between homicidal, suicidal, and accidental wounds, is decided or inferred from the characteristics of the wound after careful examination.

All the foregoing questions contribute to the solution of this the most important one. The various questions referred to above will be considered at greater length in the subsequent sections. They have been merely referred to in brief above, to show the various lines of thought a medical examiner must have in mind in making an examination.

As to the act of examination itself, the physician should conduct it in such a way as not to harm the wounded person. Often simple inspection is the most that can be done, or the examination may have to be deferred altogether until the physician in charge informs the court that an examination may be safely made. It is often necessary for the expert to get information as to the original lesion from the physician in charge. If the wound has been a fatal one and if we are called in after death, we may examine the wound on the dead body with much more freedom. Here we may examine the depth, direction, etc., of a punctured wound by cutting down on a probe or director. After careful inspection of the wound we may examine it by palpation, and go on to the dissection of the wound and the surrounding parts, tracing and noting the various vessels, muscles, etc., involved in the wound, and looking for the presence of any foreign body in the wound.

Furthermore, if the cause of death be at all obscure, we should examine not only the wound itself and the parts about the wound, but also, by an autopsy, all the cavities and organs of the body. For death may have been due to natural causes in an organ not examined, if the examination has not included all, and the physician has to disprove it.

In examining at an autopsy the depth of a wound in reference to the instrument which caused it, it should be borne in mind that the wound may be deeper than the weapon owing to a depression of the surface by the handle of the weapon. This may appear especially marked in the case of the movable viscera, as at the time of the accident the viscus may have been as near as possible to the surface, and at the examination as far as possible from the surface, as in the case of a given coil of the intestines. Also the thorax when opened at autopsy enlarges or expands a little, so that the measured depth of a wound may be greater than the weapon which caused it. Vibert[1] mentions a case of a penetrating wound of the thorax involving the heart, where the measured depth of the wound was $0^{m}.035$ greater than the length of the instrument. This may also be accounted for by a depression or flattening of the thorax by the blow, as in the case of soft parts. It is often difficult in an examination to measure accurately the depth of a wound, for one may find it hard to determine the precise end of a wound. Also, for exact measurement it is necessary to have the parts in the same position as at the time of the accident, and these parts are more or less displaced by the necessary dissection.

Besides the examination of the wound there are other points the examination of which may aid us in solving the problems presented by a case. Among these, the examination of the clothing or dress is perhaps the most important. This may indicate the weapon used in an incised or punctured wound. Contused and lacerated wounds or fractures, etc., may be produced without injuring the clothing. Blood, dirt, or grease on the clothing may throw light on the case. In self-inflicted wounds the wound in the clothing and that on the body may not and often do not correspond, as an intending suicide often (a murderer rarely) opens the clothing to select the spot for the wound. The wound in the dress is then added by a second blow not correpsonding to the first. In this way we may sometimes distinguish between a homicidal and a suicidal wound, and thus remove a false suspicion of murder or show that a wound was self-inflicted to conceal other crimes or to falsely impute it to another. The suspicion of homicide in accidental wounds may be cleared up by an examination of the dress, as in the following instance related by Taylor:[2]

---

[1] Ch. Vibert: "Précis de Médecine Légale," 2d Ed., p. 205.

[2] Taylor's "Medical Jurisprudence," 11th Amer. Ed., 1892.

A woman was found dead in bed with two indentations about the middle of the right parietal bone, a large superficial clot here and three ounces of clotted blood between the dura mater and skull, which latter was fractured over an area of four inches. No other cause of death was found. The evidence brought out the facts that she had been knocked down the evening before, about 7:30 o'clock, by a man accidentally running into her. She fell on the back of the head, was stunned, raised up, and stimulated; she then walked home, ate her supper, and was last seen at 9 o'clock by a fellow-lodger who let her in and noticed nothing unusual. The next morning she had evidently been dead some time. Suspicion fell upon the lodger, who had often quarrelled with her, and the two claws of a hammer found in his room corresponded more or less closely with the two indentations found in the skull. At the adjourned inquest, however, the *bonnet* worn by the deceased at the time of the accident was found to have two indentations on the back of it corresponding to those on the woman' s skull and containing dust and dirt, and rendering probable what from the history seemed unlikely, that the fall in the road caused the fatal injury. The examination of the dress thus avoided an unjust accusation of murder.

Contused and lacerated wounds and fractures or dislocations may be produced without injury to the dress, especially if the latter be elastic or yielding. The comparison of the wound in the clothing with that on the body may indicate the position of the body at the time of the blow. The examination of the clothing of the injured person may indicate a struggle which would support the idea of homicide. A blunt instrument may indirectly cause an injury by striking something in or on a person's clothing. Instances have been reported where a wound has been caused by an article in the pocket, or worn outside the clothing, without any trace of an injury to the clothes or pocket lining.[1]

The examination of the dress may further show which of several cuts or stabs was first inflicted. This is shown by the staining of the edges of the cuts in the clothing, the edges of the first cut or stab showing no blood-stain or only on the inner surface, as the knife is clean of blood on entering and all that is removed by the clothing on its withdrawal is found on the inner edges. If the edges of the cuts in the outer layers of clothing are bloody, it is evident that the knife was already bloody when used, and the corresponding wound was not the first inflicted.

---

[1] London Lancet, Jan. 21st, 1893, and N. Y. Med. Journal, March 11th, 1893, and May 13th, 1893.

The imprint of the bloody hand of the assailant may sometimes be found on the clothing of the one injured, and is especially important as evidence, when the hands of the assaulted are not bloody. In the case of a severe wound, especially if it is likely to become the object of a criminal investigation, the physician should always require to see the dress of the wounded. The examination of the clothing which the accused wore at the time the assault took place may give important evidence by showing evidences of a struggle or blood-stains. Absence of the latter would not prove the innocence of the accused, as the clothes actually worn may be destroyed and others substituted, or the marks and stains may be removed. In the latter case, the eye of a medical man may detect traces of blood which otherwise would go unnoticed, and a microscopical and chemical examination would reveal the real character of the stain.

Besides the examination of the clothing of the accused, the examination of his person may furnish evidence of his being engaged in a more or less desperate struggle by the scratches, marks of nails, contusions, bites, etc., on the face, neck, front of chest, forearms, and hands. If the accused should attempt to explain these wounds and spots, the latter may or may not verify the explanation, and thus additional evidence may be obtained as to the guilt or innocence of the accused.

It is well for the medical expert, as well as for others, to collect the statements of the wounded person relative to the circumstances of the injury. Also, if the accused will vouchsafe any such statements we may compare these with one another and with the facts indicated by the wound, etc.

Other points to examine, especially in cases of suspected suicide, may be briefly mentioned. The presence of the weapon in the hand of the victim and firmly grasped indicates suicide, if it corresponds to the weapon causing the wounds, for otherwise it may have been used for defence. If not in the hand, note the spot where the weapon was found. In the case of a suicide, the hand as well as the weapon held by it is likely to be bloody, also in case of murder the generally empty hand is apt to be bloody, as the hand is naturally carried to the wound.

We cannot further describe the many points which the medical examiner should bear in mind in making an examination in a medico-legal case, without repeating too fully what will be given at greater length in subsequent sections, reference to which should be made for further particulars. Tardieu proposed as a basis for examining and studying wounds, (1) to visit the wounded person and see what state he is in, and to determine (2) the nature, (3) the cause, (4) the consequences of the wound. Also if the wounded person is dead (5) to examine the body for the cause of death in order to see if the latter is due to the wound. Also (6) to determine thec ircumstances of the affray.

The description of a wound should be given in plain language, avoiding the use of scientific terms or expressions, so as to be readily understood by judge and jurors. Otherwise the usefulness of the medical expert is very much diminished. The description should also be precise and sufficient to justify the conclusions arrived at as to the cause of a wound, its gravity and results, and the weapon used. With a view to exact statement in description, it is well to take notes as to the result of the examination and not depend merely on memory. The object of the witness should be to be understood and not to be thought thoroughly scientific.

WAS THE INJURY INFLICTED BEFORE OR AFTER DEATH?

This is a question which may often be asked in cases of fatal injuries, and it is one which must be answered as definitely as we are able, for the defence may rest on the assertion that the wound or injury was post mortem and not ante mortem. What are the means we have to enable us to answer the above question? The most important factor is the condition of the blood and the changes that it undergoes after death. For some hours after death the body retains its animal heat. As long as this is retained rigor mortis does not set in and the blood is more or less fluid. This period varies, but on the average it does not last longer than eight or ten hours. Before this time, however, the blood has begun to undergo certain changes. These changes result in the inability of the blood from a post-mortem wound to coagulate completely. At first the greater part may coagulate, but after a time coagulation is less and less complete, and the coagula are not as firm as those from the blood of a living person. The period at which these changes occur also varies, but they may generally be clearly noticed from three to four hours after death, or even sooner. In the first two to four hours after death, therefore, as far as the condition of the blood is concerned, it may be difficult or impossible to say whether a wound was made before or soon after death. In other words, this difficulty exists as long as the tissues of the body live after the body as a whole is dead.

There are certain general pathological or occasional conditions of the body in which the blood during life does not coagulate at all or only imperfectly, as in scurvy and in the case of the menstrual blood. Also blood in a serous cavity, especially if it be abundant or there exists inflammation, is found to coagulate not at all or only imperfectly. Post mortem the blood remains liquid long after death in cases of death by drowning, asphyxia, etc., and in such cases hemorrhage may be free in a wound made some time after death. Furthermore, after putrefaction has set in the blood again becomes more or less liquid, and may flow away from a wound like a hemorrhage, but it no longer coagulates.

The principal signs of a wound inflicted during life are (1) hemorrhage, (2) coagulation of the blood, (3) eversion of the lips of the wound, and (4) retraction of its sides.

1. HEMORRHAGE varies in amount with the size of the wound, the vascularity of the part, and the number and size of the large vessels involved. In incised or punctured wounds the amount, as a rule, is quite considerable. If there is a free exit most of the blood runs off; the rest stays in the wound, where it soon coagulates with the exceptions mentioned above. But besides partly filling the wound in the form of a clot, the edges of the wound are deeply stained with the coloring matter of the blood, and this stain cannot be removed by washing. This staining involves especially the muscular and cellular tissues.

Further, a hemorrhage during life is an active and not a passive one; the blood is forced into the interspaces of the tissues in the vicinity of the wound, and is found infiltrated in the cellular tissue, the muscles, the sheaths of the vessels, etc. It is here incorporated, as it were, with the tissues so that it cannot be washed away. In an ante-mortem wound the arterial nature of the hemorrhage may show by the marks of the jets of blood about the wound or on the clothes or surrounding objects. When a large vessel has been divided and the exit for the blood is free, this may run off without infiltrating the tissues or even staining the edges to any considerable extent, and there may remain but little in the wound. In the case of lacerated and contused wounds the amount of hemorrhage is less, but rarely fails entirely, and if the wound is in a vascular part it is liable to cause death from hemorrhage, though a whole limb may possibly be torn off without much hemorrhage. In the latter case, however, there are usually found clots of blood adhering to the edges of the lacerated wound and the ends of the vessels. In contusions where there is no wound of the skin the blood is prevented from flowing externally, and its accumulation and distribution form an ecchymosis. Here again we see the active power of the hemorrhage which infiltrates between the tissues, stains them deeply, and appears either as a mere stain or in fine clots incorporated, as it were, with the tissues or partly occupying a cavity formed by an extensive displacement of the surrounding parts. The amount of blood varies under the same conditions as in incised wounds, and also according to the greater or less disintegration of the tissues by the blow, allowing a larger or smaller central cavity to be formed. In "bleeders" the amount of the hemorrhage does not vary under the normal conditions, but a fatal hemorrhage may occur from a very insignificant wound. After hemorrhage from a wound made during life the veins are empty about the wound, especially those situated centripetally, while normally after death the blood is mostly aggregated in the veins. They are the source of post-mortem hemorrhage, but do not empty themselves to any great extent.

The *hemorrhage from a wound made after death* may be extensive if the blood remains fluid as in the cases mentioned above, *i.e.*, after death from drowning or asphyxia or after the commencement of putrefaction. Otherwise the amount of hemorrhage decreases with the length of time after death, until the blood loses its fluidity and hemorrhage no longer occurs. In general, it is slight unless a large vein is opened, for the veins are the source of the hemorrhage. There is usually scarcely any hemorrhage after the first two to four hours. This applies also to subcutaneous hemorrhages or ecchymoses. These post-mortem hemorrhages are passive and not active, consequently there is less infiltration of blood into the surrounding tissues, which merely imbibe it, and the stain is less deep and may be washed off the edges of the wound, in contrast to the stain of ante-mortem wounds. After putrefaction has set in the hemorrhage may be more abundant, as the blood is driven to the surface by the formation of gas in the abdomen and thorax. At the same time, the coloring matter of the blood transudes through the walls of the veins and is imbibed by and stains the tissues, so that it may be impossible to distinguish it from a true ecchymosis. Fortunately these conditions are of small moment, as an examination is seldom deferred so long.

CADAVERIC ECCHYMOSES show almost invariably while the body is still warm and the blood more or less liquid, *i.e.*, during the first eight or ten hours after death. They are not due to injury or violence before or after death, but they may closely resemble ecchymoses produced on the living body and be mistaken for them. This is the more important as they are quite constant on the cadaver.

In this connection, it may be said that an ecchymosis due to a blow before death may not show till after death, as it requires some time for a deep ecchymosis or even an ecchymosis covered by a thick layer of skin to show superficially. Thus a man kicked in the abdomen died thirty-five hours after the injury from peritonitis, due to a rupture of the bladder. No ecchymosis appeared at the site of the injuries until after death. It is not uncommon in cases of hanging to observe an ecchymosis along the course of the cord appearing only after death. Huize met with a case of this description. Devergie remarked that on the bodies of those drowned ecchymoses are often hidden for a time on account of the sodden state of the skin, and they appear only after the water has evaporated, which may require some days. Furthermore, it is not necessary to survive long after an injury in order that an ecchymosis may show post mortem. If the blood is fluid at the time of the blow and any capillaries or larger blood-vessels are torn, then we may have an ecchymosis though death be almost instant. Casper thought that it required some time before death for an ecchymosis to develop, and that if the person injured by a contusion died soon after the injury, an ecchymosis would not appear after death. There are many well-authenticated cases to prove that Casper's opinion is wrong. Among the most famous of these is that of the Duchesse de Praslin.[1] She was attacked and killed by her husband while she was asleep in bed. The thirty or so wounds showed a mortal conflict, and she could not have survived more than one-half hour, and yet after death there were numerous ecchymoses from the contusions.

Another case is also mentioned by Taylor.[2] A young man died suddenly after a blow from a companion, having been struck in the side a fortnight before by a heavy box, which knocked him senseless and nearly killed him. The post mortem revealed an ecchymosis on the side which on the authority of Casper's opinion was attributed to the old injury. The color of the ecchymosis would be sufficient to settle all such doubts, as the changes of color would have fully developed or the color even disappeared in part in fourteen days' time.

An ecchymosis made post mortem does not undergo the color changes seen in ecchymoses during life, unless the tissues are œdematous in which the ecchymosis occurs. These changes in color have already been described, the deep blue changing to violet in eighteen to twenty-four hours at the earliest. In support of the foregoing and disproving Casper's views, Christison found that within two hours after death severe blows on a dead body are followed by a livid discoloration, similar to those produced by a blow shortly before death. This livid discoloration is due to the effusion of a very thin layer of blood external or superficial to the true skin, sometimes in a stratum of the true skin or more rarely into the cellular tissue, staining deeply the partition walls of the fat-cells. Of course, a more or less recent contusion or ecchymosis on a dead body was not necessarily produced at the same time as the cause of death. It should be borne in mind in this connection that ecchymosis is not a necessary result of a blow or contusion.

---

[1] Ann. d'Hyg., 1847, t. 2, p. 377.

[2] Taylor: "Medical Jurisprudence," 11th Amer. Ed., 1892.

According to Devergie, ecchymosis does not appear when a blow inflicted post mortem is received by skin directly covering a bony surface beneath, and rarely appears where there is a large amount of fat and no solid point of resistance beneath the site of the blow.

We have already referred to the fact which Portal long ago remarked, namely, that the spleen has been ruptured without ecchymosis or abrasion of the skin. The same absence of ecchymosis has been noticed in cases where the liver, stomach, intestines, bladder, etc., have been ruptured as the result of contusing blows.

The following case cited by Taylor[1] illustrates this point. Henke reported the case of a man who died of peritonitis a few hours after fighting with another man. There was no mark on the skin or ecchymosis, though there existed peritonitis from rupture of the small intestine. The blow was proven by direct evidence, and though some medical witnesses on account of the absence of external signs thought that no blow could have been struck, others of more experience admitted that it could have been the cause of the rupture.

Watson[2] reports a similar case of a girl nine years old who received a blow from a shoe on the abdomen. This was followed by great pain, collapse and death in twenty-one hours. No marks of injury were visible externally, but peritonitis existed from rupture of the ileum.

A similar case is reported by Williamson,[3] where peritonitis resulted from complete rupture of the ileum without any trace of injury externally, though the blow was struck by the hoof of a horse.

Another case was brought into Guy's Hospital[4] who had been run over by an omnibus. No injury was discoverable, though the wheel had passed over the chest and abdomen. He died of peritonitis, however, which set in on the second day, and on post-mortem examination the liver and small intestines were found ruptured.

---

[1] "Med. Jurisprud.," 11th Amer. Ed., 1892.

[2] "On Homicide," p. 187.

[3] Med. Gaz., May, 1840.

[4] Guy's Hosp. Gaz., 1873.

Christison thought as the result of his experiments and experience that the most reliable signs of an ecchymosis made during life, and distinguishing it from one caused by a blow after death, were as follows: The skin of the ecchymosed area is generally much darkened and discolored from blood infiltrated through its entire thickness; the skin is also much firmer and more elastic from swelling of the part if the contusion is received some hours before death. But we may have an effusion beneath and not in the substance of the skin, and the above signs might possibly be due to an injury inflicted only a few minutes after death. The above signs may therefore be absent, and when present are not absolutely indicative of an injury received during life. In general, the effects of severe contusions inflicted soon after death may closely resemble those of slight contusions received during life.

There is little danger of contusion if the blow be inflicted on a dead body after the loss of body heat and the beginning of rigor mortis.

2. Coagulation of Blood.—As stated at the beginning of this section, blood from a wound inflicted during life coagulates with the exception of that from those suffering from certain pathological or occasional conditions or in certain locations, already mentioned. This coagulation is not immediate, but is complete in about five minutes. The entire amount of blood lost is thus coagulated and the coagula are firm. These coagula (if the wound is not interfered with) occur in the opening of a wound and on its edges, especially at the mouths of the blood-vessels, which are thus plugged. The blood which infiltrates the interspaces of the tissues is coagulated in the form of these interspaces. The same is true of the blood of an ecchymosis whether there be a hematoma or only an infiltration between the tissues, or both. These clots represent more or less the form of the space occupied by the blood. In the case of the scalp a subcutaneous clot may be mistaken for a depressed fracture of the skull from the fact that the edges of the clot become very hard while the centre is still quite soft. A wound in which a large artery has been divided may present very little clotting in the wound if the opening is free and the blood has mostly escaped in a jet.

In a wound produced soon after death there may be some clotting, but less in amount, firstly, because there is less hemorrhage, and, secondly, because not all the blood clots. These conditions increase with the length of time after death, so that after a time a wound made on a cadaver would show very little if any clotting owing to very slight hemorrhage, and little or no clotting of the blood extravasated. When the body has lost its animal heat and rigor mortis has begun to set in, then there is no more coagulation of the blood and no more hemorrhage, under normal conditions, for the blood has mostly become clotted in the vessels of the body. Consequently, with the exception of wounds inflicted very soon after death, we can distinguish an ante-mortem from a post-mortem wound by the condition in which the blood is clotted. If there is any hemorrhage, the wound being inflicted before the loss of animal heat, and the blood remains entirely fluid on the surface or in an ecchymosis we know that the wound was produced after death and some hours after death; unless any of those conditions exist in which the blood does not normally coagulate. If the hemorrhage is slight or quite moderate in amount and venous in character, if the blood is only clotted in part and the clots are rather soft and do not form a plug at the mouth of each artery, and especially if the staining of the walls of the wound can be washed off, then the wound was probably produced post mortem, but not so long after death as in the first case supposed. If the characters of the hemorrhage and the clotting are still more like those normal to a wound inflicted during life, then, as a rule, it is impossible to say from these two features of the wound, hemorrhage and clotting, whether the wound was inflicted during life or a very short time after death.

3. Eversion of the Lips of the Wound.—The edges or lips of a wound inflicted during life may be inverted, instead of everted, if a thin layer of muscular fibres is attached directly to the deep surface of the skin, as is the case in the scrotum. The eversion of the edges of the skin is due to their elasticity, and ceases to occur as soon as the skin loses its vitality. Consequently eversion ceases to occur soon after death, within a very few hours. A wound in which the edges are neither inverted or everted was therefore inflicted after death. If this sign is present and marked, the wound was inflicted during life or within two or three hours or less after death. If this sign is

present but very slightly marked, the wound may have been made even somewhat longer after death.

4. RETRACTION OF THE SIDES OF THE WOUND is also dependent on their vitality and ceases to occur when this is lost a few hours after death. In the retraction of the sides of the wound we have all the parts involved, but unequally. The muscles, arteries, skin, and layers of connective tissue all retract, varying in the degree of retraction according to the order in which they are named. In different parts of the body this comparative order of retraction is liable to more or less variation. Every surgeon is familiar with this retraction of the tissues, which necessitates certain rules in the technique of operations, especially of amputations. Muscles retract the more the longer they are and the farther the incision is made from their attachment. Without specifying a definite time, we may say that, as a rule, this retraction lasts no longer than about two hours after death, consequently when it is absent we may infer that the wound was inflicted two hours or more after death. The amount of retraction grows less and less after death for about two hours, after which it is very slight if it occurs at all, owing to the loss of elasticity of the tissues. This sign is especially useful in the case of a mutilated body where, by examining the degree of retraction of the muscles, we may infer whether the mutilation was done before or after death. The sides of a cut made on the cadaver are comparatively smooth and even, owing to the absence of the unequal retraction of the various elements, which makes the surfaces of a gaping ante-mortem wound uneven and irregular. Relying on these circumstances in the "affaire Ramus," cited by Vibert,[1] one was able to recognize the order in which the body had been mutilated.

OTHER MINOR SIGNS of a wound inflicted during life may be briefly mentioned. If the edges of the wound are swollen, or show signs of inflammation or gangrene, or if pus or adhesive material is present on the edges of the wound, we may infer that the wound was inflicted some little time before death. Of course, if cicatrization has commenced, some days must have elapsed before death after the wound was received. If the blow causing a contusion was inflicted some time before death, there will be more or less of a general swelling of the region, partly due to the blood effused, but also partly due to œdema.

---

[1] Vibert: "Précis de Médecine Légale," 2d Ed., 1890.

It is not always easy to say whether a *fracture* was produced while the body was living or dead. If the body was still warm when a post-mortem fracture was produced there is little difference from an ante-mortem fracture, except that there may be a little less blood effused. In a fracture produced after rigor mortis has set in there is little or no blood effused. In the case of fractures the presence of callus, indicating the process of repair, shows that the accident occurred during life, and, as we have already seen, we may form some idea of the length of time elapsed between the injury and the time of death. On the cadaver it is said to be harder to cause fractures and lesions of the skin than on the living body. Casper says that fractures of the hyoid bone and the larynx are impossible after death, and he also was not able to rupture the liver or spleen.

In distinction to the characteristic signs of a wound inflicted during life, we may mention briefly some of the signs of post-mortem wounds when the wound has been inflicted from two to ten or twelve hours or more after death:

(1) The hemorrhage is slight in amount and may fail altogether.

(2) The character of the hemorrhage is venous, corresponding to the source of the hemorrhage from the veins, the arteries being nearly empty after death.

(3) The edges of the wound are not deeply stained, and this staining may be removed by washing. The spaces between the tissues are not infiltrated with blood.

(4) The blood remains either entirely fluid or, if there are clots, these are *softer* than those in an ante-mortem wound, and only a portion of the blood is thus clotted. There are no clots plugging the open mouths of the arteries on the surface of the wound; the veins may or may not be closed by an imperfect clot.

(5) The skin of the edges is not everted or inverted.

(6) The sides of the wound do not gape and their surfaces are smooth and even, as the tissues are not unevenly retracted.

RÉSUMÉ.—It is very easy from the foregoing to distinguish between a wound inflicted before death and one ten or twelve hours after death.

If the hemorrhage has been abundant and arterial, if it has infiltrated between and deeply stained the tissues and the stain cannot readily be washed off; if the blood coagulates completely and the coagula are firm and are found lying in the wound, plugging the vessels, and incorporated with the tissues between which they lie; if the edges of the skin are everted and the sides of the wound are retracted and uneven—under these circumstances, we may be sure that the wound was inflicted during life or a very short time after death. If, on the contrary, the hemorrhage is slight in amount or almost fails altogether; if it is venous in character; if the edges of the wound are only stained by imbibition of the blood, which is not infiltrated between the tissues, and the stain may be washed off; if the blood is not at all or only slightly clotted and the clots are soft; if the skin is not everted and the sides of the wound are smooth and lie nearly in contact; if there are no clots plugging the divided arteries on the surface—then we need have little hesitancy in saying that the wound was produced after death, but probably not later than ten or twelve hours after death. If the wound was inflicted still longer after death and before putrefaction, then we would have a lack of the signs due to hemorrhage, clots, staining, etc. If we find the conditions more or less midway between the first two, we may be left in some doubt as to the date of the injury. Thus if the hemorrhage is moderate, the blood mostly but not altogether clotted and the clots moderately firm, the skin slightly everted, and the sides slightly separated and not altogether smooth on their surface; if the surfaces are fairly deeply stained and the stain cannot be easily washed off—then we can only say that the wound was inflicted during life or within two hours or so after death, and this fact is often enough for the purposes of the medico-legal inquiry.

The same is the case with contusions where there is no bleeding externally. If we have a bluish, violet, green, or yellow tumor with or without more or less superficial œdema; if this tumor fluctuates or is hard, but in either case is elastic; if on incision the skin and the tissue spaces are infiltrated with blood which is coagulated, or if there is a cavity filled with clotted blood, the coagulum being firm and the entire amount of blood coagulated—then the wound was inflicted during life. If, however, the surface shows a bluish or violet color, little or no swelling of the skin, which is of natural thickness, and the ecchymosed area is not tense and elastic to the touch; if further the blood is found on incision to be fluid or if coagulated only partly so, and the blood is not infiltrated into the tissue spaces, but merely imbibed by the tissues—then the blow was inflicted after death, and probably more than two or three hours after.

In contusions especially we may have difficulty, as the sign of fluidity of the blood may fail and putrefaction may modify the conditions of the wound unless parts deep beneath the surface be examined.

We see, then, that in some cases it is very easy to say that a wound was inflicted post mortem. If a wound was not inflicted until ten or twelve hours after death or even sooner, we cannot easily mistake it. But in many cases it may be hard or impossible to say whether a wound was inflicted during life or within an hour or two after death. Here we must be cautious in expressing an opinion, which should be guarded. But we should remember that it is important to be able to state that a wound was inflicted before or immediately after death, as no one but a murderer would think of inflicting a fatal injury on a body immediately after death. In such cases a well-guarded medical opinion may often meet all the requirements of the case.

Granted that a given wound was produced before death. There are, then, one or two questions which may arise, and which depend for their answer on the length of time the wounded person could have lived and the physiological or muscular acts which he could have performed after receiving the injury and before death. The first of these questions may be expressed as follows:

COULD THE VICTIM HAVE PERFORMED CERTAIN ACTS AFTER HAVING RECEIVED HIS FATAL INJURY? The term "certain acts" here refers to almost any thing or things which would require time and strength—in other words, the continuance of life with bodily and mental powers for a certain time after receiving a mortal injury.

This question may be raised in relation to an attempted alibi of the accused, who may have been proved to be in the presence of the victim a moment before death. If after this moment the victim has moved from the spot or performed certain acts before death, the attempted alibi may depend upon the answer to the question as to whether the given acts of the victim were compatible with the fatal character of the wound. An alibi can aid in the acquittal of the accused only when the nature of the injury was such that death would be supposed to be immediate or nearly so. Great care should be taken on the part of the medical witness in answering this question, for after very grave wounds, proving speedily fatal, the victim sometimes can do certain acts requiring more or less prolonged effort, as shown by numerous examples. Wounds of the brain are especially noticeable in allowing a survival of several hours, days, or even weeks, during which time the injured person may pursue his occupations. Where the survival has lasted days or weeks, the alibi has no importance, but not if the survival is of shorter duration. The following case is cited by Vibert[1] and may be mentioned in this connection, though the wound was caused by a bullet which traversed from behind forward the entire left lobe of the brain. After the injury the victim was seen by several witnesses to climb a ladder, though with difficulty, for he had right-sided hemiplegia. He was found insensible more than half a mile away, and did not die until six or eight hours after the injury. Severe injury of important organs is sometimes not incompatible with an unexpectedly long survival. Devergie cites two illustrations of this which are quoted by Vibert.[1] A man received several extensive fractures of the skull, with abundant sub-dural hemorrhage, and rupture of the diaphragm with hernia of the stomach. The stomach was ruptured, and nearly a litre of its contents was contained in the left pleural cavity. Notwithstanding all this, he was able to walk about for an hour or so and answer several questions. He died only after several hours. Another man, crushed by a carriage, received a large rupture of the diaphragm, complete rupture of the jejunum, and rupture and crushing of one kidney. Yet he walked nearly five miles, and did not die until the next day.

More rarely wounds of the great vessels are not immediately fatal. M. Tourdes is quoted by Vibert[1] as citing the case of a man who descended a flight of stairs and took several steps

[1] Vibert: "Précis de Médecine Légale," 2d Ed., 1890.

after division of the carotid artery; also of one who lived ten minutes after a bullet-wound of the inferior vena-cava.

Even wounds of the heart are not as speedily fatal as is commonly supposed, and often permit of a comparatively long survival.

Fischer[1] found only 104 cases of immediate death among 452 cases of wounds of the heart, and healing occurred in 50 cases among 401. Ninni[2] found from the combined statistics of Jamain, Latelenet and Fischer that immediate death occurred in only 19 per cent of cases of penetrating wound of the heart. Vibert[3] mentions two striking cases of long survival after wounds of the heart. A woman received a stab-wound which perforated the right ventricle, causing a wound one centimetre long. She did not die until twelve days later, when on autopsy there was found an enormous extravasation of blood in the left pleural cavity and pericardium. The second case, though one of bullet-wound, is equally applicable and instructive in this connection. A man received a bullet-wound which perforated the left ventricle, the bullet being found later in the pericardium. After being wounded he threw a lamp at his assassin which set fire to the room. He then went into the court-yard, drew some water, carried it back in a bucket, extinguished the fire, and then lay down on his bed and died.

In studying the wounds of different regions of the body, we may find many other mortal wounds which, though speedily fatal, leave the possibility of more or less activity before death. We see, therefore, that even in those wounds which are commonly supposed to be immediately fatal, even by many medical men where attention has not been called to the exceptions, such exceptional cases are not uncommon in which death is not immediate. Time and even strength may thus be allowed for more or less complicated activity. An alibi cannot, therefore, be allowed without question on the part of the medical expert, who must exercise great caution in expressing an opinion. The second question which may sometimes arise in connection with the last, though it has little to do with the subject of this section, is the following:

---

[1] Vibert: "Précis de Médecine Légale," 2d Ed., 1890.

[2] Giornale internazionale delle scienze mediche, Jan. 15th, 1899.

[3] Quoted by Vibert from the "Traité de pathologie externe" of Follin and Duplay.

HOW LONG BEFORE DEATH HAD THE DECEASED ACCOMPLISHED CERTAIN PHYSIOLOGICAL ACTS? For instance, how long after a meal did he die? This is hard to answer with precision, as digestion varies with the individual, and digestion begun during life may go on to a certain extent after death. We may be able to say if digestion has just commenced, is well advanced, or has terminated. What was eaten at the last meal may be learned by the naked eye, the microscope, the color of stomach contents and their odor. The state of the bladder and rectum is sometimes called in question. All the above facts have less bearing on the case than those in relation to the former question.

THE CAUSE OF DEATH FROM WOUNDS.

The cause of death should be certain and definite. In reality, there is only one real cause, though one or many circumstances may be accessory causes. In most cases of death from the class of wounds which we have been considering, there is no difficulty in determining the cause of death so as to be able to state it definitely. But if the deceased had recovered from the first effects of the wound and then died, or if death seems as much due to disease as to injury, then the *real* cause of death may be obscure. If the medical witness is in doubt as to which of two causes was the primary cause of death the doubt should be stated at once, as it may weaken the testimony if brought out later.

Wounds may be directly or indirectly fatal. They are directly fatal if the victim dies at once or very soon after the wound, with no other cause internally in his body or externally from his environment. Wounds are indirectly or secondarily fatal if the injured person dies from a wound disease or complication, the direct consequence of the wound, or from a surgical operation necessary in the treatment of the case. Wounds may also be necessarily fatal either directly or secondarily, or not necessarily fatal. In the latter case death may be due as much, if not more, to other causes than the wound, and sometimes not at all to the wound itself. Thus death may be due to natural causes, latent disease, an unhealthy state of the body, imprudence or neglect of treatment, or improper treatment, etc. These various degrees of responsibility of a wound as the cause of death we will now consider more at length.

I. Was the Wound the Cause of Death Directly?

If so, it must have caused death in one of the following ways:

1. Hemorrhage.—This may act by producing syncope. But the amount of the hemorrhage may not be sufficient for this result, and still cause death by disturbing the function of the organ into which it is effused, as in the brain or in the pleural or pericardial cavities. The blood here acts mechanically. Blood in the trachea may also kill mechanically by causing asphyxia.

The *amount* of hemorrhage required to produce syncope varies under a variety of circumstances. Less is required in the very young, the aged, and the diseased, also less in women than in men. Young infants may die from hemorrhage from very slight wounds, even from the application of a leech or the lancing of the gums. A sudden loss of blood is much more serious than an equal amount lost slowly. This is the reason that the wound of an artery is more serious and more rapidly fatal than a similar loss of blood from other sources. It is hard to specify the absolute quantity which must be lost in order to cause death by syncope. The total blood in the body is about one-thirteenth of the weight of the body, making the total amount of blood weigh about twelve pounds. Of this, about one-fourth is in the heart, lungs, and large blood-vessels. According to Watson, the loss of an amount varying from five to eight pounds is enough to be fatal to an adult. But less is enough to prove fatal in many cases, as the rapidity of the loss of blood and the age, sex, and bodily condition of the wounded person affect the amount necessary. Though death from a small artery is slower than that from a large one, yet it may occur in time, as shown in the instance quoted by Taylor,[1] where a man bled to death in thirty-eight hours from the wound of an intercostal artery. Thus, too, a wound of the branches of the external carotid artery is often enough to cause death, and a wound in a vascular part may cause death from hemorrhage, though no vessel of any size be divided.

Internal hemorrhage may be fatal from mechanical interference with the function of an organ, as well as from syncope. Thus we may have death from syncope due to hemorrhage into the peritoneal cavity or, after contusions, into the intercellular spaces and the cavity due to the blow, into which several pounds of blood may be extravasated. I have seen an enormous subcutaneous extravasation in the lumbar region. Internal hemorrhage is most fatal when due to the rupture of a viscus such as the heart, lungs, liver, kidney. Taylor[1] cites a case of a man run over and brought to Guy's Hospital in November, 1864. He had pain in the back, but there were no symptoms or marks of severe injury. He left the hospital and walked home, where he was found dead in bed a few hours later. His abdomen contained a large amount of blood from the rupture of a kidney. After severe flagellation blood may be effused in large quantities beneath the skin and between the muscles, which is just as fatal as if it had flowed externally from a wound. In fact, if the injuries are numerous the loss of much less blood is enough to prove fatal, the element of shock here assisting that of hemorrhage.

---

[1] "Med. Jurisprud.," 11th Amer. Ed., 1892.

How are we to ascertain whether a person has died from hemorrhage? This may be more difficult in the case of an open wound, for the body may have been moved from the spot where it lay after the wound was received, and the blood on the body, clothes, and surrounding objects may have been removed. Then the case may be presumptive only, but we may arrive at a definite conclusion by attention to the following points: If the wound was in a very vascular part and of some size, or if a large vessel or many moderately large vessels were divided and the vessels, especially the veins in the neighborhood, are empty, then we may be quite sure of death from hemorrhage. If there is no disease found which could be rapidly fatal the case is still stronger. The body should be pallid after fatal hemorrhage, but the same may be the case from death from other causes. In case the body and surrounding objects have not been disturbed, then the amount of clotted blood in the wound, on the body and clothes, and about the body, taken in connection with the foregoing points, can leave no doubt. We should remember, however, that not all the blood about the body was necessarily effused during life, but a little hemorrhage may have occurred after death while the body was still warm and the blood fluid, *i.e.*, during the first four, eight, or ten hours. But the amount thus lost is small. In cases of death from internal hemorrhage we do not have so much difficulty in pronouncing an opinion, as by post-mortem examination we can determine the amount of the hemorrhage. We can judge, too, from its position, whether it has acted mechanically to interfere with a vital function, and has thus caused death, or whether the latter was due to syncope from the quantity lost.

---

[1] "Med. Jurisprud.," 11th Amer. Ed., 1892.

2. **Severe mechanical injury of a vital organ**, such as crushing of the heart, lungs, brain, etc. This crushing may be accompanied by hemorrhage, but death may be more immediate than the hemorrhage would account for. The mechanical injury done to the vital centres in the medulla by the act of pithing is the direct cause of the sudden death which follows it. Exceptionally slight violence to a vital organ is fatal, but this may be better explained by attributing it to shock.

3. **Shock.**—Often an injury is apparently not enough to account for the fatal result so speedily. The marks of external injury may fail entirely or be very trifling. Thus more than once persons have died in railway collisions with no external marks of violence. So, too, a blow on the upper abdomen, on the "pit of the stomach," has been rapidly fatal without any visible injury to the viscera. Death is attributed to the inhibitory effect on the cardiac plexus, and there may be no marks externally or only very superficial ones. In Reg. *v.* Slane and Others (Durham Wint. Ass., 1872), quoted by Taylor,[1] the deceased was proved to have sustained severe injuries to the abdomen by kicks, etc., but there were no marks of bruises. All organs were found healthy on post-mortem examination, but the injured man died in twenty minutes. Death was attributed to shock and the prisoners were convicted of murder.

Death from concussion of the brain may furnish another example of death from shock. This may occur with only a bruise on the scalp and with no intracranial hemorrhage or laceration of the brain. The medical witness should be cautious in the above classes of cases in giving evidence, as the defence may rely upon the absence of any visible signs of mortal injury to prove that no injury was done, a principle fundamentally wrong.

---

[1] "Med. Jurisprud.," 11th Amer. Ed., 1892.

Also a *number of injuries*, no one of which alone could be the direct cause of death, may cause death on the spot or very soon afterward. Death in such cases, where there is no large effusion under the skin, is referred to exhaustion, which, however, is merely another term for shock. Such cases are exemplified by prize-fighters who, during or after the fight, become collapsed and die of exhaustion. Having sustained numerous blows on the body during the many rounds, the body presents the marks of various bruises, but there may be nothing else to explain the sudden death. No one injury or bruise is mortal, and yet, when the deceased was previously sound and in good health, death must be referred directly to the multiple injuries received in the fight. We have already stated above that if the injuries are numerous, the loss of a smaller amount of blood may be fatal. We see, therefore, that there is not always a specific and visible "mortal" injury to account for death. This is a well-known medical fact, but it does not accord with the erroneous popular prejudice that no one can die from violence without some one visible wound which is mortal. In other words, the non-professional mind leaves out of account the idea of shock, only regarding material injury and not functional disturbance. If the circumstances accompanying death are unknown, it is well to be cautious. But if the deceased was in ordinary health and vigor and there was no morbid cause to account for the sudden death, we need not hesitate to refer death to the multiple injuries.

II. WAS THE WOUND THE CAUSE OF DEATH NECESSARILY?

This brings up a number of interesting questions to be considered. In medical jurisprudence there is probably no condition so common as that the injury is admitted, but death is attributed to some other cause. Thus *if there are several wounds* it may be hard to decide on the relative degree of mortality of any particular one, so as to be able to say that death was directly or necessarily due to this or that one. The defence may plead that death was not necessarily due to the particular wound attributed to the prisoner. This brings up the question—

Which of two or more Wounds was the Cause of Death? No general rule can be laid down for all cases, but each case must be judged by itself. Another way of putting the question is: "*Which of two or more wounds was mortal?*" The questions are not quite synonymous, for two or more of the wounds might be "mortal" but not equally the cause of death. In fact, as we have already seen, no one of the wounds if they are multiple may be of itself mortal, but taken together they are so. Consequently we will suppose that there are but two wounds, and not multiple ones, and the question remains which of these wounds was the cause of death. A wound may be said to be of itself mortal when it is the cause of death directly or indirectly in spite of the best medical assistance. In some continental states mortal wounds are divided into two classes, those absolutely and those conditionally mortal, the former including those in which the best medical assistance is at hand, sent for or timely rendered without everting the result. The mortal result in the second class is conditional on want of treatment, improper treatment, or accidental circumstances. As Taylor says, it is better to look at the effect of the wound and the intent of the assailant, as is done in English law, rather than at accidental relations of the wound.

To return to the question, we can readily imagine that a man may receive two wounds at different times or from different persons, and die after the second wound. Taylor[1] mentions the following case in which the question arose as to which of two injuries caused death: In Reg. *v.* Foreman (C.C.C. February, 1873) the prisoner had struck the deceased some severe blows on the head. A fortnight later, having partially recovered, another man gave him some severe blows on the head. A fortnight later still he had left hemiplegia, and died in a few days of a large abcess in the brain. The question arose which set of blows had been the cause of the abscess. The prisoner, the first assailant, was acquitted, as the deceased had had no serious symptoms until the second assault, and there was no satisfactory medical evidence as to the relation of the two assaults to the abscess formation. The same author also supposes the following case: A man having received a gunshot wound of the shoulder is doing well, when in another quarrel he receives a penetrating stab-wound of the thorax and abdomen. He dies after lingering for a time, under the effects of these wounds. If the wound of the shoulder could be proven to be the cause of death, the second assailant could not be convicted of manslaughter, and so too with the first assailant if it could be shown that the victim died of the stab-wound. It might be possible for a surgeon to decide the question definitely at once if death occurred soon after the stab, which was found to have penetrated the heart, a large blood-vessel, or one of the viscera; or, on the other hand, if the stab-wound was found to be superficial and not penetrating, and the wound in the shoulder had suppurated and caused septicæmia.

---

[1] Taylor: "Medical Jurisprudence," 11th Amer. Ed., 1892.

In either or any case, everything would depend upon the evidence furnished by the medical witness. His knowledge and judgment are required to distinguish the guilty from the innocent.

Again, sometimes death may appear to be equally the result of both wounds, in which case, as far as the medical evidence goes, both assailants would be liable to the charge of manslaughter. Or the second wound may be accidental or suicidal, and again the question would arise as to the cause of death. A case illustrating this is told by Taylor[1] substantially as follows: A grocer's assistant pursued a thief, who had stolen from a cart, into a coal-shed, where he was stabbed twice in the abdomen. The larger wound suppurated, the smaller wound healed up, and the man died of peritonitis. On post-mortem examination the suppurating wound was found not to involve a vital part, while the small healed wound had wounded the liver and gall bladder and had set up the fatal peritonitis. The large suppurating wound had apparently been inflicted purposely; the fatal wound, directed upward and backward, might have been accidental by the deceased rushing upon the knife held more or less in self-defence. The case never came to trial, as the assailant was never found, but it can be readily imagined what complications might have arisen.

Furthermore, the wounded person may have taken poison or been subsequently ill-treated, and he may have died from these causes rather than the injury. But the question arises as to whether the wound was necessarily the cause of death. Here, in order to exculpate the assailant, the supervening disease or maltreatment must be such as to account for sudden or rapid death under the symptoms which actually preceded death.

---

[1] Taylor: "Medical Jurisprudence," 11th Amer. Ed., 1892.

Was Death Due to Natural Causes? Again, the injury may be admitted, but it may be claimed that death is due to natural causes. It is not unusual for wounded persons to die from natural causes, though the case may appear otherwise to laymen. This is often seen with suicidal wounds, especially those inflicted during the delirium of a disease, or the disease may supervene later and cause death without relation to the wound. Where the wound was inflicted by another, accurate discrimination is especially important in order to save the accused from imprisonment under false accusation and consequent loss of character. A careful examination is the only way to determine such cases, which depend therefore on the medical testimony.

Again, the question may arise as between DEATH FROM WOUNDS OR LATENT DISEASE, the wound perhaps being admitted, but death being attributed to latent disease. Here a close attention to symptoms and a careful post-mortem examination can alone decide. A man may die from the rupture of an aneurism, from an apoplexy or some other morbid condition after receiving a severe wound. Or a man with a hernia may receive a blow upon it causing a rupture of the contained intestine followed by peritonitis and death, or the recipient of a blow may have a calculus in the kidney which may perforate a blood-vessel or the kidney tissue and set up a fatal hemorrhage as the result of a blow.

Thus, medically speaking, the result of the injury is unusual and unexpected, and due to an abnormal or unhealthy state of body of the wounded person.

If it can be clearly shown by the medical testimony that death was due to the above or any other latent diseases, the responsibility of the assailant may be lessened or removed. The law looks to this point and is lenient in its punishment in the absence of malice on the part of the assailant. The crime is still manslaughter and may even be murder if the assailant was actuated by malice and the abnormal or unhealthy state of the body of the victim was taken advantage of. Generally there is no intention of murder, but the nature of the wound and the means of infliction will help to show this, which is for the jury rather than the medical witness to decide.

There is less ground for mitigation of the punishment if the assailant was aware of the peculiar condition of the wounded person, especially in the case of those notoriously ill or of pregnant women.

Closely allied with this subject are those rare cases where ABNORMAL ANATOMICAL CONDITIONS, such as a thin skull or brittle bones, cause a slight injury to be followed by unexpected and untoward results, not to be looked for in the average individual. In such cases the evidence of the abnormal condition furnished by the medical witness may diminish the responsibility and mitigate the punishment.

Furthermore, the responsibility of the assailant may not be altogether removed, for the question naturally arises, Was death accelerated by the wound? This depends upon the circumstances in each case upon which the medical witness must base his opinion. Maliciously accelerating the death of another is regarded as criminal on the principle that that which accelerates causes. The following cases are quoted from Taylor[1] to illustrate the above distinctions. In Reg. *v.* Timms (Oxford Lent Ass., 1870) the deceased had been struck on the head by the accused with a hatchet, from which injury he had partly recovered under treatment in twelve days. But six weeks later he was seized with inflammation of the brain, with convulsions, and died. At the autopsy disease of the kidneys was found, and death was referred to this and the inflammation of the brain due to the blows. The prisoner was convicted after the judge had charged the jury that it was manslaughter if they believed that the blows conduced in part to the death of the deceased.

In the following cases there was no connection between the violence and the cause of death. A man struck his father on the head with a hammer and was sentenced to two months' imprisonment, as the injury did not appear serious. The father thought the punishment too little, became much excited, and was hemiplegic six days after the wound was inflicted and died three days later. No injury of the brain was found under a fracture of the inner table at the site of the blow, but a large clot was found in the lateral ventricle which, in the opinion of the medical witnesses, was not dependent on the blow, and the prisoner was acquitted (see Reg. *v.* Saxon, Lancashire Sum. Ass., 1884). Also in Reg. *v.* Hodgson (Leeds Sum. Ass., 1876) the prisoner had struck his wife with a belt, a short time after which she fell back and died suddenly. The cause of death was found to be heart disease, and the blow not being causative in producing the fatal result, the prisoner was acquitted. Or again in Reg. *v.* Thompson (Liverpool Sum. Ass., 1876): The prisoner had stabbed his wife in the cheek. The wound was severe but not mortal. Two days later she was delivered of a child in the infirmary to which she was taken. She died nine days later of puerperal fever. The prisoner was acquitted on the charge of murder, as there was no necessary connection between the wound and the puerperal fever. Acquittals have taken place in cases of death occasioned by terror or dread of impending danger produced by acts of violence, as in the case of Reg. *v.* Heany (Gloucester Lent Ass., 1875). Here the prisoner in an altercation with his wife, who was suffering from cancer, held up a knife in a threatening manner, but did not touch her. This gave her a shock; she died two days later from fright. As there was no distinct proof that death was accelerated by this act, the prisoner was acquitted of the charge of murder. Taylor[1] found among a large number of cases occurring in England during twenty years that the latent causes of death, as registered in wounded persons, were chiefly inflammation of the thoracic or abdominal viscera, apoplexy, diseases of the heart and large blood-vessels, phthisis, ruptures of the stomach and bowels from disease, internal strangulation, and the rupture of deep-seated abscesses. Sometimes the person was in good health up to the time of injury, while in other cases there was merely a slight indisposition. It was only by carefulness on the part of the medical experts that the true cause of death was ascertained.

---

[1] Taylor: "Medical Jurisprudence," 11th Amer. Ed., 1892.

Again, it may be claimed that DEATH was not necessarily the result of the wound and was AVOIDABLE BY GOOD MEDICAL TREATMENT. There are many cases of wounds not mortal with proper and skilful treatment which might become so by improper treatment. They may thus become directly mortal by interfering with a source of hemorrhage which had been arrested, or secondarily mortal by infection of the wound by meddlesome treatment. It would depend on the medical witnesses to determine whether and how far the treatment had been responsible for the fatal result. If the wound is not of itself mortal and it has only become so from improper treatment, this should be a mitigating circumstance in favor of the accused. Medically speaking, we can seldom make the sharp distinction which Lord Hale did legally between a wound becoming mortal from improper treatment and one in which improper treatment causes death irrespective of the wound. In case of a slight wound this distinction might be possible, but not so in case of severe wounds. Also there would probably be no conviction, as far as the medical evidence is concerned, if the wound was only mortal in consequence of improper treatment and not mortal as its usual and probable result. This may naturally introduce the question of the COMPARATIVE SKILL IN TREATMENT. If death is entirely or partly due to a wound the responsibility of an assailant is not altered by unskilful treatment. The entire question of the relation of the wound to the fatal result and the effect on this result of the treatment employed is left to be determined by the medical experts, and in its solution great care and judgment must be used. Although a given fatal wound might not have caused death under the best possible treatment and surroundings, yet, according to the above rule, the assailant is held responsible as long as the fatal result is due partly, at least, to the wound. Therefore we see the responsibility of the surgeon not only for the life of his patient, but also for that of the prisoner. He should, therefore, not deviate from the ordinary and most accepted practice in such cases, as any such deviation is taken hold of by the counsel for the defence. In fact, every point of the treatment is subjected to criticism.

---

[1] Taylor: "Medical Jurisprudence," 11th Amer. Ed., 1892.

In a lacerated wound of the foot, if death occurs from tetanus, it may be claimed that death would not have occurred if the foot had been amputated, or, if the foot were amputated and death followed, it may be claimed that amputation was unnecessary and was the cause of death. The surgeon should, therefore, be able to give the best reasons for every step of treatment.

Again, it may be claimed that DEATH was not a necessary result of the wound and WAS AVOIDABLE BUT FOR IMPRUDENCE

OR NEGLECT on the part of the wounded person. A man after being wounded may refuse to receive medical assistance, or, after receiving it, may disobey instructions or refuse to submit to an operation proposed. Thus with a compound depressed fracture of the skull the patient may either refuse to see a surgeon, or he may refuse to submit to an operation proposed, or he may with or without operation disobey the instructions as to diet and quiet, and eat or drink heavily and refuse to go to bed. Such a case we can readily imagine might die of meningitis, etc.

If the symptoms of a wound are unfavorable from the start, or if the wound of itself is likely to prove mortal, the responsibility of the assailant is not mitigated by imprudence or neglect of medical assistance by the wounded person, as a sane man is a free agent and is not obliged to call in or submit to medical treatment. Moreover, a medical witness in many cases could not swear that an operation or other plan of treatment would certainly save life. Thus an amputation of the leg for wound of the foot causing tetanus is by no means a certain cure. But we can readily imagine a case where the refusal to submit to the treatment proposed might be an important element in causing death. Thus in a compound depressed fracture of the skull with compression, the medical witnesses would agree that the operation would in all probability save life. This fact would probably be only mitigatory in diminishing the penalty, and, as stated above, would not secure acquittal. But it is none the less important for the medical witness to bear these facts in mind and bring out the facts and conclusions clearly in his testimony.

DEATH FOLLOWING SLIGHT PERSONAL INJURIES.—Here again the claim might apparently be justified that death was not necessarily due to the trifling injury. And in reality there is commonly some unhealthy state of the body to explain such an unexpected result. When the disease accounting for this unhealthy state of the body is in some other part than the injury, an examination with ordinary care will explain the case. But if the disease and injury are located in the same part, especially in the head, the case is more perplexing, but may be cleared up by careful and thorough examination. Also the usual results of such an injury should be considered, and whether the disease would be a usual result of the injury, or whether the sum total of the pathological conditions found would be accounted for by the violence. It should be remembered that the presence of chronic disease is no excuse. Thus Taylor[1] cites the case of Reg. *v.* Hapley (Lewes Aut. Ass., 1860), where a boy with chronic disease of the brain suffered from no unusual symptom until he received a severe flogging, which was followed by death in less than three hours. The same author mentions also the following case to show that fatal results may follow very slight and trivial blows. Annan[2] tells of a healthy four-year-old girl who received a slight blow from the shaft of a wheelbarrow on the skin about three inches below the knee. There was even no external mark of violence, and the injury was thought to be so slight as not to require treatment. There was pain, however, which increased on the following day, marked constitutional symptoms appeared, and the child died on the fourth day. Death has been imputed even to the punishment inflicted by schoolmasters.

When DEATH OCCURS FROM WOUNDS AFTER LONG PERIODS the injury may be admitted, but it may be claimed that death was not necessarily due to the wound. Medically speaking, death is just as much the result of the injury as if it occurred on the spot. Of course, death must be clearly traceable to the usual and probable results of the injury, and not be dependent on any other cause. An examination of the wounded part and of the whole body will enable the medical witness to determine the cause of death and whether it is clearly traceable to the injury. A doubt on this point may lead to acquittal. Certain forms of wounds or wounds in certain localities are especially liable to end fatally after a long delay, but as the direct result of the wound. These are wounds of the head and of the spine. As to the first class, the injured person may apparently recover and be doing well, when he may suddenly die from a cerebral abscess, for instance. This is the result of the injury, but remains a longer or shorter time latent. In wounds of the spine the patient is generally paralyzed below the point of fracture, but is apparently in good health. In a longer or shorter time he may die of a pneumonia, cystitis, or bedsores, which are the known and regular consequences of the injury or injured condition. Astley Cooper cites the case of a man who was injured on the head and died two years later from the effects of the injury, as was clearly made out by the continuance of brain symptoms during the entire period. An interval of eleven years occurred in another head injury between the injury and the fatal result. The first result of the injury was concussion of the brain, and the case is mentioned by Hoffbauer.[1] This long interval is unusual. There is a rule in English law by which the assailant cannot be indicted for murder if the victim of the assault lives a year and a day. Practically this makes little difference, as nearly all cases would die within that time; but the principle is wrong as looked at from the medical standpoint. The protracted cases concern, as above stated, mostly injuries of the head, spine, and chest, among which there are some cases, like the examples cited, where, according to English law, justice would fail to be done.

---

[1] Taylor: "Medical Jurisprudence," 11th Amer. Ed., 1892.

[2] Med. Times, 1854, ii., p. 238.

III. Was a Wound the Cause of Death Secondarily?

A wound is secondarily the cause of death when the victim, having recovered from the first ill effects, dies from some wound disease or accident or from a surgical operation rendered necessary in the proper treatment of the wound. There may be much difficulty in establishing the proof of death from a wound as a secondary cause, for, 1st, the secondary cause must be in the natural course of things; and, 2d, there must be no other accidental circumstances to occasion the secondary cause.

The secondary cause may be partly due to the constitution of the deceased from habits of dissipation, which fact would serve as an expiatory circumstance in the case. Among the secondary causes of death may be mentioned the wound diseases septicæmia, pyæmia, erysipelas, tetanus, gangrene, also the wound accident—as we may call delirium tremens, and surgical operations rendered necessary to the treatment of the case. We may add, besides the regular wound diseases, inflammation in and about the wound, septic in character, perhaps not justifying the title of septicæmia, but which, with its accompanying fever, may be the "last straw" in a case which might otherwise recover. Some of the secondary causes will now be considered more at length.

---

[1] "Ueber die Kopf-Verletzungen," 1842, p. 57.

Septicæmia is a general febrile disease due to the absorption into the system of the products of bacteria, 1, from the material contained within a wound, and, 2, from the tissues surrounding it. Depending on the two sources of origin, we have two forms of septicæmia: 1. Septic intoxication or sapræmia, due to the absorption of a chemical poison, ptomaïnes, etc., and usually readily influenced and cured by the removal of the source of the poison in decomposing blood-clots, secretions, etc. 2. Septic infection comes on less rapidly but is more serious than the former is, if properly and quickly treated, because the source of the trouble cannot be so readily removed, for it is in the tissues. The latter form is the more common one in wounds, though the former may occur in abdominal wounds, especially when a blood-clot is present. The first form begins promptly and acutely, the second form more gradually. The infection in septicæmia takes place through a wound and may be due to the weapon which caused the wound, the unclean condition of the parts wounded, or to the subsequent treatment or want of treatment. It may even take place through the intestinal mucous membrane as in cases of tyrotoxicon poisoning. It is most likely to occur during the first four or five days, before the surfaces of the wound granulate, and it consists in the invasion of the tissues by bacteria, especially staphylococci and streptococci. The disease is characterized by severe constitutional symptoms, acute continuous fever, inflammation of certain viscera and of the wound, and nervous disorders. Marked leucocytosis is usually present. A pronounced chill ushering in the fever is often absent. Prostration is especially marked, the patient finally passing into a typhoid condition indifferent to surroundings. Anorexia and headache are usually present; diarrhœa is common, vomiting is not. The skin is pale and dusky, and commonly somewhat icteric; at first it is hot and dry, later moist and finally cold and clammy. The spleen is often enlarged. The pulse becomes weak and rapid and delirium is followed by coma. The prognosis is grave. Antiseptic treatment generally prevents and often cures the disease, as is the case with many other of the wound diseases; hence the failure to employ it may be alleged by the defence in mitigation of the responsibility of the assailant for the fatal result.

PYÆMIA is closely allied to septicæmia. It is due to the setting free of bacterial or septic emboli from a broken-down, septic thrombus in the neighborhood of the wound, and the circulation of these emboli in the blood until they are arrested and form the characteristic metastatic abscesses, especially in the lungs, joints, abdominal viscera, and parotid gland. Almost always the source of infection is an infected wound. Granulation does not prevent the occurrence of pyæmia, which, as a rule, commences at a later stage than septicæmia. It is most important, however, for our purpose to remember that there is such a thing as spontaneous pyæmia, or pyæmia from a concealed cause. An injury not causing a wound may here be the exciting cause, but the resulting pyæmia is an unexpected consequence. A bruise of the bone, for instance, by allowing bacteria, which in certain conditions may be circulating in the blood, to find an exit from the vessels into the bruised part, may develop an acute osteo-myelitis, which may be a starting-point of a pyæmia. It is but proper to state, however, that spontaneous pyæmia is a rare occurrence. In fact, it is so rare that if pyæmia occurs and we find ever so trifling an infected wound, we can safely attribute the pyæmia to the wound and not to a concealed origin.

Pyæmia begins, as a rule, in the second week of the healing process or even later. It usually begins with a chill, which may be frequently repeated. The fever is very irregular and exacerbations occur with each metastatic abscess. The skin is icteric, the icterus being hematogenous. The pulse is rapid and becomes weaker. Infective endocarditis may develop, which increases the danger of metastatic abscesses, which may then occur in the brain. Otherwise the mind is clear and unaffected until the final delirium and coma. The disease may become chronic, but usually lasts a week or ten days. The prognosis is very grave.

ERYSIPELAS is a still more frequent complication of medicolegal wounds, and though not so fatal as the two preceding, it is probably more often the secondary cause of death on account of its far greater frequence. It too is an acute infectious inflammation involving the skin and cellular structures and sometimes the mucous membranes. It is due to the presence of a micro-organism, *streptococcus erysipelatis*, probably identical with the streptococcus pyogenes. This occurs mostly in the lymphatics of the skin, and effects an entrance through some wound or abrasion of the skin or mucous membrane, which may be almost microscopic in size. Probably there is no such thing as true *spontaneous erysipelas*, though the wound may be often overlooked and only visible on the closest examination. If a wound has been inflicted, the size and severity of it cannot be alleged as a reason why it was not the starting-point of an erysipelas. The erysipelas must be clearly traced to the injury. That is, it must occur before recovery from the wound or not later than a week after it has healed, for the incubation is probably not longer than this. It is difficult to connect an erysipelas with a wound if it occurs some time after it has healed or if it occurs at a different place and not about the wound. Wounds of certain regions, as, for instance, scalp wounds, are especially liable to develop erysipelas, but this is probably owing to the imperfect antiseptic treatment or delay in applying it. Certain individuals are more prone to it than others; thus it has been stated that blondes and those suffering from Bright's disease are more susceptible, though how true this is it is hard to say. It is also probably more prevalent at certain times of the year, particularly in the spring. A wound after it has scabbed over or has begun to granulate, that is, after the first four or five days, is very much less apt to serve as the avenue for infection. Erysipelas usually begins with a chill, or a convulsion in children. Nausea and vomiting are the rule. The fever is of a septic remittent type and ranges from 102° to 104° F., and the temperature may be subnormal when the inflammation is subsiding. Prostration is marked and the pulse more or less weak. There may be delirium while the fever is high. Locally there is rarely anything characteristic until twenty-four hours or so after the chill. Then we have the appearances of an acute dermatitis with a reddish blush and some tension, burning and itching of the skin. At first the redness is most marked about the wound, later at the edge of the advancing, serpentine margin. It spreads widely and rapidly, and after three or four days the part first attacked begins to improve. Desquamation follows. The duration may be a week or ten days or as long as a month. The inflammation may be much more severe, involving the subcutaneous connective tissue in *phlegmonous erysipelas*.

FACIAL ERYSIPELAS is a common variety and was once regarded as idiopathic, but a wound on the skin or mucous membrane is probably always present. The prognosis of erysipelas is usually favorable. Since the use of antiseptics it is far less common than formerly, though still the most common of the infectious wound diseases.

If a man wounded in an assault is taken to a hospital where erysipelas prevails the question of responsibility arises for, medically speaking, he is subjected to great and avoidable risks.

TETANUS is an infectious disease characterized by tonic muscle-spasms with clonic exacerbations and affects chiefly the central nervous system. It almost always, if not always, originates from a wound and is due to infection by a specific bacillus. Tetanus, like erysipelas, is probably always traumatic and never strictly idiopathic. The wound may be so slight as to escape notice. It is said that the weather influences the development of tetanus, and that it is more common in the tropics. There are also certain sections where tetanus is much more common than elsewhere and where it may be said to be almost endemic. Punctured wounds are most likely to be followed by tetanus, for they offer the best opportunity for the development of the bacteria, which are anaërobic. Wounds in dirty parts of the body, like the hands and feet, are more apt to be followed by tetanus than those elsewhere. Tetanus usually appears toward the end of the first week after a wound has been received, but it may not appear for a longer period, even three or four weeks, so that the wound may have been some time healed. To connect tetanus with a particular wound, note (1) if there were any symptoms of it before the wound or injury, (2) whether any other cause intervened after the wound or injury which would be likely to produce it, and (3) whether the deceased ever rallied from the effects of the injury. Tetanus comes on suddenly without warning. The injured person first notices that he cannot fully open the mouth, he has lock-jaw, and the back of the neck is stiff. The muscles of the abdomen and back are next involved so that the back is arched in the position known as *opisthotonos*, and the abdomen presents a board-like hardness. The muscles of the fauces, pharynx, and diaphragm may next become involved, causing difficulty in swallowing and breathing. The thighs may or may not be involved, but the arms and legs are almost never affected unless the wound was situated there. Owing to the spasm of the abdominal muscles, micturition and defecation are difficult and respiration is hindered. The muscles are in the condition of tonic spasm which permits the patient no rest, the face bears the "risus sardonicus," and the suffering is extreme. If the patient lives more than two or three days the tonic spasm partly gives way to increased reflex irritability, in which a noise, jar, or draught of air may give rise to clonic and tonic spasms in the muscles affected. The patient may die at such times from tonic spasm of the respiratory muscles, or he may die of prostration from want of food and sleep, worn out by the suffering and muscular spasm. The mind is usually clear to the last. Fever is not characteristic of the disease. Tetanus may be rapidly fatal; in two or three days, or it may be or become more chronic. The *prognosis* of acute tetanus is almost invariably bad; that of chronic tetanus is grave, but a certain proportion of cases recover.

Diagnosis.—This is easy. It differs from a true neuritis in the peripheral nerves in that no matter where the wound is situated the first symptom is in the muscles of the jaw and the back of the neck, and not at the site of the injury and distally from this point. *Trismus* is applied to a milder form of the disease in which only the face and neck muscles are involved and "lock-jaw" is a prominent symptom. Some cases of *tetany* may be mistaken for so-called spontaneous tetanus. Tetany is a non-specific disease—a neurosis. It may follow childbed fevers, mental shocks, exposure to cold and wet, extirpation of goitre, intestinal irritation, etc. It is characterized by painful tonic spasms of the muscles of the extremities. The attacks last one-half to two hours or more, and may be preceded by a dragging pain. They may be brought on by pressure on the nerve leading to the muscles affected. Striking the facial nerve often causes contraction of the face muscles. There is no trismus, but there may be opisthotonos. The patient seems well between the attacks and most cases recover without treatment.

DELIRIUM TREMENS may occur as a secondary consequence of injuries, or necessary surgical operations, in the case of those who are habitually intemperate. Those who habitually use opium, tobacco, cannabis indica, or even tea or coffee to excess are said to be subject to it. It may, therefore, be justly alleged that death is avoidable in very many cases, but for an abnormal and unhealthy state of the body. The disease is characterized by delirium, a peculiar tremor of the muscles, insomnia, and anorexia. Pneumonia may complicate the case. The patients die in fatal cases from exhaustion due to insomnia, lack of nourishment, and their constant activity of body and mind. The prognosis is usually favorable, taking all cases together, but in delirium tremens secondary to surgical injuries or operations the prognosis is serious.

DEATH FROM SURGICAL OPERATIONS performed for the treatment of wounds. The operation is a part of the treatment, and if it is done with ordinary care and skill the accused is responsible for the result. The necessity and mode of operation must be left to the operator's judgment. As the defence may turn on the necessity for and the skilful performance of the operation, it is well to wait for the advice and assistance of others if practicable, for death is not unusual after operations necessitated by severe injuries. The patient may die on the operating-table after losing little blood, from fear, pain, or shock. Or he may die from secondary hemorrhage or any of the sceondary causes of death from wounds enumerated above. The evidence of the necessity of the operation must, therefore, be presented by the operator. If an operation is necessary and not performed, the defence might allege that death was due to the neglect of the surgeon. Another question for the medical witnesses to determine is whether the operation was rendered necessary because of improper previous treatment, for in that case the responsibility of the assailant may be influenced. The meaning of the term "necessity" is here a matter of importance. Unless an operation is necessary to the preservation of life there is some doubt whether the assailant is responsible if death occurs. But, medically speaking, we would not hesitate to urge an operation on a wounded man in order to preserve function, or even to save deformity as well as to save life. In the case of operations done under a mistaken opinion which are neither necessary to save life nor, as the result proves, to save function or guard against deformity, the assailant may be relieved from responsibility if death follows. Thus an aneurism following an injury might be mistaken for an abscess and opened with skill but with a fatal result. It is also for the medical experts to determine whether an operation was unnecessary or unskilfully performed, for if it were and death resulted from it, the responsibility of the prisoner is affected unless the original wound would be likely to be fatal without operation. According to Lord Hale, if death results from an unskilful operation and not from the wound, the prisoner is not responsible. But yet death may occur as the result of the most skilful operation necessary to the treatment of a wound, and not be dependent at all on the wound itself. If the operation is skilfully performed, and yet the patient dies from secondary causes, such as those above enumerated or any others, the prisoner is still responsible, and the medical testimony is concerned with the performance of the operation and the secondary causes of death. The relative skill of the operator or surgeon is probably not a question for the jury in criminal cases, on the ground that the man who inflicts the injury must take all the consequences, good or bad. In a civil suit, for instance an action for malpractice, the case is otherwise, and all the medical facts and opinions are submitted to the jury. The law regards three circumstances in death after surgical operations: (1) The necessity of the operation, (2) the competence of the operator, and (3) whether the wound would be fatal without operation.

Death may occur *from anæsthetics* used in an operation without any recognizable contributing disease of the patient, or any carelessness or lack of skill in the administration of the anæsthetic. Of course, the question of absence of contributing disease on the part of the patient and of its proper administration must be satisfactorily answered in cases of death from the anæsthetic in an operation rendered necessary in the treatment of a wound. Death from an anæsthetic may occur before, during, or after an operation itself. Medically speaking, the necessity of the use of an anæsthetic in operations cannot be questioned, and in emergencies where an operation becomes necessary, and not a matter of choice, its use, with special care, is justifiable even with an existing organic disease, which usually contraindicates it. As death may be alleged to be due to the use of a particular anæsthetic, it is always best in operating on account of an injury which may require a medico-legal investigation to use that anæsthetic which is most generally used and indorsed in the particular section of country in question. Of course, it is not lawful to operate against the will of a person who preserves consciousness and will. It may be added in this connection that if a medical man be guilty of misconduct, arising either from gross ignorance or criminal inattention, whereby the patient dies, he is guilty of manslaughter, according to Lord Ellenborough. Omissions or errors in judgment, to which all are liable, are not criminal.

IV. WAS THE WOUND MADE BY THE INSTRUMENT DESCRIBED?

It is not often necessary to prove that a weapon was used, though it may affect the punishment. For the use of a weapon implies malice and intention and a greater desire to do injury. The prisoner may swear that no weapon was used when the nature of the wound clearly proves that one was used. The explanation of the prisoner of the origin of the wound may thus be discredited. We cannot often swear that a particular weapon was used, but only that the wound was made by one similar to it in shape and size. Thus Schwörer tells of the case of a man stabbed in the face by another. The medical witness testified that the wound was caused by a knife shown at the trial which had a whole blade, but a year later the point of the knife which had really caused the wound was discharged from an abscess in the cheek at the site of the wound. The surgeon thus made a too definite statement in regard to the knife shown.

It is often very difficult to answer the above question. We base our opinion chiefly on two sources: 1st, and most important, by an examination of the wound, and, 2d, by an examination of the instrument said to have been used. Certain particulars of the wound may furnish indications as to the weight, form, and sharpness of the instrument used. There are certain wounds which must have been made by an instrument, namely, incised and punctured wounds. The above question is determined more or less by what has been said in a former section on incised and punctured wounds, but we will now consider what special features of these and other classes of wounds indicate the nature, shape, size, etc., of the weapon used.

Incised wounds must be made by a cutting instrument. We would here exclude those contused wounds of the scalp and eyebrows which closely resemble incised wounds, but we have already seen that we can diagnose between these wounds and incised wounds by careful inspection. The locality should also put us on our guard, so that in case of wounds of these two regions we should be especially careful in making the examination.

In the case of incised wounds we cannot often tell the shape or size of the weapon, but we are able to tell certain characteristics about it. *The sharpness* of the instrument may be inferred from the clean and regular edges. The depth of the wound may also indicate the sharpness of the weapon. A long "tail" in the wound indicates that the weapon was sharp as well as that this was the part of the wound last made. If the edges of the wound are rough, we may infer that the edges of the weapon were rough and irregular. Wounds caused by bits of china or glass or fragments of bottles, besides having rough and lacerated edges, are characterized by an irregular or angular course in the skin.

Some cutting weapons, like an axe, act as much by means of their weight as by their cutting edges. Wounds caused by such weapons we can often distinguish by the following signs: The edges are not as smooth as is the case with a cutting instrument like a knife, and they may be more or less lacerated and show signs of contusion. The wound is often deep in comparison with its length, and the ends of the wound are abrupt instead of slanting up from the bottom to the surface. The section of resisting organs and the impression of the edge of the weapon on the bone are further signs of the use of such a weapon.

The form and direction of a wound may possibly give some indication of the form of the instrument—for instance, whether it be straight or curved like a pruning-knife, as in the case cited by Vibert[1] of a wound of the neck which suddenly became deeper toward its extremity and changed its direction; the whole being explained on the supposition that it was made by a pruning-knife.

But it is in **punctured wounds** especially that we are enabled most often and most accurately to determine the kind of a weapon used. Here from the form of the wound we may judge of the form and size of the weapon. In speaking of punctured wounds in a former section we divided them into four groups, reference to which may here be made. In the first group, or those caused by cylindrical or conical weapons, when the weapon is very fine it may leave no track at all; if a little larger, we may infer from a linear bloody track that the weapon was needle-like in shape. The length of the instrument or the depth to which it penetrated may be found, as a rule, only by dissection. If the weapon were larger and conical, we have seen that the wounds would be linear with two angles, the length of the wound being parallel to the direction of the fibres in the skin.

---

[1] "Précis de Médecine Légale," 2d Ed., 1890, p. 203.

Here we may judge of the form of the weapon from the following circumstances: From a comparison of the depth with the size of the opening, we know that it was a punctured wound. The edges and angles are not smooth and even enough for a stab-wound with a knife, for the edges are torn and not cut, and such a stab-wound would be the only form of wound with which we would be likely to confuse it. Furthermore, the direction of the long axis of the wound parallel to that of the skin fibres in the region in which it occurs and the very slight retraction of the edges distinguish it from a stab-wound made by a knife. By these signs we can almost always distinguish such wounds from knife stab-wounds, and thus tell the form of the weapon used. As to the size of weapon used, these wounds if of any size are generally smaller than the weapon, for the skin is put on the stretch by the weapon and yields to a certain extent only. The actual wound, therefore, is smaller in circumference than the weapon. The size of the wound is smaller than that part of the weapon occupying the wound when the weapon was arrested; it may be very much smaller than the weapon at its largest point. Small wounds of this kind are generally larger than the instrument producing them.

The second group of punctured wounds, or *stab-wounds* made by a cutting instrument, are by far the most common and, therefore, the most important variety of punctured wounds. If the *stab-wound* is *perpendicular* to the surface the *form* of the wound may represent pretty closely that of the weapon at the point where the latter was arrested, whether it has a single or double cutting edge. But even here there are exceptions. Frequently a weapon with a broad back and only one cutting edge may produce a wound resembling that of an instrument with two cutting edges, the second angle tearing as in the former class of wounds. Here on close examination we can sometimes distinguish the difference between the two angles, and judge correctly of the shape of the weapon. In fact, wounds made by common pocket-knives are regularly slit-like and not wedge-shaped, as the wound is caused only by the cutting edge of the knife. Again, if the single cutting edge is blunt, in rare cases the wound is produced in the same manner as those made by conical and cylindrical instruments. We would be led to suppose that the wound was produced by such an instrument, since both angles are torn, unless the direcion of the wound might not follow that of the fibres of the skin, in which case we would be left in doubt. Stab-wounds are sometimes angular from the knife being withdrawn in a slightly different direction from that in which it was introduced or from an unequal retraction of the skin (see Fig. 9). If the *stab-wound* is *obliquely directed*, we can still judge of the general *shape* of the weapon, with exception of the cases above mentioned. The dimensions and size of the weapon are here much harder to determine. The *dimensions* of a stab-wound in the skin may be the same as those of the weapon, or of that part of the weapon which is arrested in the wound, but often they are not so. To measure the size of a wound exactly so as to get at the exact size of the instrument, we should place the region of the wound in the same position, etc., that it was when the wound was inflicted, and this we cannot often do. As the skin was tense or relaxed at the time the wound was inflicted, so the wound in the skin appears smaller or larger, just as with a sheet of rubber under similar conditions. If the instrument is very blunt, the wound in the skin may be smaller than the weapon whether the skin near the wound is tense or not. Thus Hofmann saw the wound from a blunt bayonet one centimetre less than the weapon.

The wound of the skin may be shorter and broader than the weapon used on account of retraction of the edges of the wound, and this is especially marked when the wound lies transversely to the direction of the skin fibres. On the other hand, the length of the external wound is more often greater than that of the weapon, because the wound is elongated by making pressure toward the cutting edge on withdrawal of the weapon, and an oblique wound measures longer than the weapon. If the blow is from above downward and the cutting edge of the weapon is uppermost, the length of the wound is not so likely to be increased much beyond the measurement of the weapon as when the cutting edge is directed downward. There is but one condition in which a stab-wound is at all likely to correspond in dimensions with that of the weapon, and that is when the wound is perpendicular to the surface. Even here the wound may be lengthened on withdrawal of the weapon, and we have to allow for retraction of the edges and try to put the parts in the same condition of tension or laxity as at the time of wounding. Even in the most favorable case, therefore, we cannot with certainty tell the exact size of the weapon. If a stab-wound be directed obliquely to the surface, then the length of the wound is greater than that of the weapon, unless this increase be exactly counterbalanced by the lateral retraction of the wound. The size of the weapon in such oblique wounds is further obscured by the changes of size of the wound due to withdrawal of the weapon, retraction of the edges, and the condition of tension of the skin at the time the wound was inflicted.

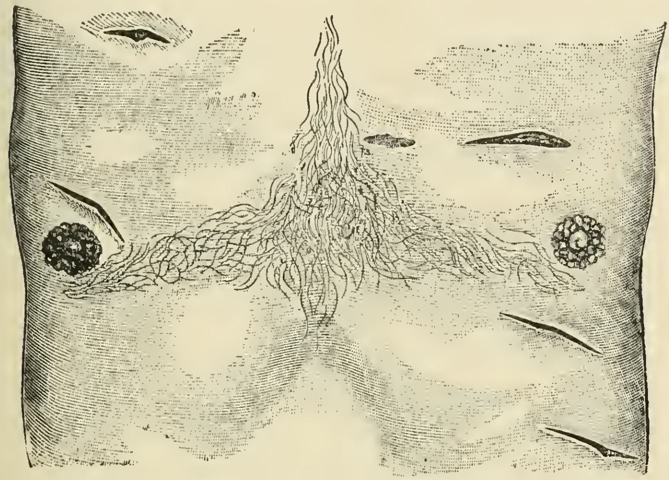


FIG. 9.—Angular Stab-Wounds of the Anterior Chest Wall caused by a Strong Pocket-Knife.

Dupuytren remarks that stab-wounds are smaller than the weapon owing to the elasticity of the skin, but a lateral motion of the weapon may cause considerable enlargement of the wound. If a stab-wound has traversed a part of the body, the wound of exit is smaller than that of entrance.

The *depth* of a punctured wound may be any part of the length of the weapon, or it may even be deeper than the length of the weapon owing to a depression of the surface by the force of the blow, or by the pressure of the handle of the weapon or the hand holding it. We have already seen that this may occur in a marked degree in penetrating wounds of the abdomen involving one of the movable viscera, also in wounds of the thorax, partly from depression of the surface and partly from an expansion of the thorax when opened at the autopsy, thus increasing the measured depth of the wound. Punctured wounds of the third class made by instruments with ridges or edges, like foils, files, etc., present more or less the shape of the weapon if the edges are cutting, but not always so if the direction of the wound be oblique or the parts unevenly stretched. If the edges are not cutting they cause wounds more or less like the first class of punctured wounds, but we can often distinguish them from the latter by little tears in the edges. The entrance and exit wounds may not be alike.

Wounds made by bits of *glass and earthenware* have irregular and uneven edges. Taylor[1] relates a case, Reg. *v.* Ankers (Warwick Lent Ass., 1845), where the wound was attributed to a fall on some broken crockery, but the wound was cleanly incised and the prisoner was convicted. As it may be alleged in defence that a given wound was caused by a fall on broken crockery or other substances capable of producing a punctured wound, it is important to notice whether the edges are lacerated and irregular or smooth and clean. The author quoted above cites another case which occurred to Watson, where the prisoner alleged that a deep, clean-cut wound of the genitals of a woman which had caused her death was due to a fall on some broken glass. The character of the wound disproved this defence. Another feature of such wounds, especially if they be deep in comparison to their length, is that they are very apt to contain small particles of the glass or earthenware which caused them. In fact, in all wounds it is well to search for any small fragments which will throw light upon the weapon used.

---

[1] "Med. Jurisprud.," 11th Amer. Ed., 1892.

Wounds caused by *scissors* are often of characteristic shape. If the scissors were open we find two symmetrical, punctured diverging wounds, presenting more or less clearly the form of the blades of the scissors. If the blades have been approximated after the puncture is made there is a triangular interval between the punctures, the apex of which is truncated if any skin remains between the punctures.

Lacerated wounds may not indicate the weapon used as clearly as punctured wounds, but the agent which produced them is often indicated by the appearance of the wound. They are generally accidental. But where they occur, as they not infrequently do, on the bodies of new-born children, they may give rise to the charge of infanticide. In some cases the weapon which caused the wound fits the wound produced, and thus important evidence may be furnished the prosecution. Taylor[1] cites the case of Montgomery (Omagh Sum. Ass., 1873), where a bill-hook which fitted the injuries on the skull of the deceased was found buried in a spot to which the prisoner was seen to go. These facts connected the prisoner with the weapon and the weapon with the murder. In other cases the wounds may be so lacerated or contused that the indications of the weapon are obscured.

Contusions and Contused Wounds.—The shape of a contusing body is sometimes reproduced by the contusion and the ecchymosis. Thus we are enabled to distinguish the marks of a whip, the fingers, the fist, etc. This is best seen when the ecchymosis is fresh, for soon the edges extend and the outline is less clearly marked. Plaques parcheminées, which we have already described as the marks of contused erosions, may show the form of finger-nails, etc. Contused wounds like simple contusions may show the shape of the weapon.

If the contusing body has a large area, the whole of this area cannot often strike the body at once, so that the outline of the contusion does not represent that of the weapon. In general, severe contusions present greater difficulties than the preceding classes of wounds. We must generally be content if we can determine whether the wound was caused by a weapon, including the fist, or by a fall, and we are often unable to tell even this. A fall is often alleged by the defence as the cause of the injury, but of course if the prisoner was responsible for the fall he is responsible for the results of the fall. If there are contusions or contused wounds on *several parts* of the head, or if the wounds are on the *vertex* of the head, it is presumptive of the use of weapons. We cannot often swear that each and every wound on the head was due to the use of a weapon. On the other hand, the presence of grass, sand, gravel, etc., in a wound is presumptive of a fall and of the origin of the wound in this manner. In case of a fall from a height the wound or wounds might be in almost any part of the body, on the vertex or elsewhere. Such a fall may be the result of accident, suicide, or murder. It is not unusual for female complainants to ascribe their wounds to a fall to exculpate the prisoner, especially if this happens to be her husband. We should remember that in the scalp or over the eyebrows a contused wound caused by a blunt instrument may resemble an incised wound. As already stated, however, if the wound is fresh careful examination will lead to a correct opinion, and the use of a sharp instrument may be disproved. If the wound is not recent there is great difficulty in judging of the cause. It is well to caution against accepting the interested statements of others in regard to the use of a weapon, unless the character of the wound bears them out very strongly. There may be a bad motive for imputing the use of a certain weapon to the assailant. It is far better to rely solely upon the evidence furnished by the wound in such cases.

---

[1] Taylor, "Med. Jurisprud.," 11th Amer. Ed., 1892.

It would be useful if we could lay down some general rules to discriminate between wounds caused by the blow of a weapon and those caused by falls, but this we are unable to do so as to cover all cases. Each case must be judged by itself.

If the question is asked *which of two weapons* caused certain contusions or contused wounds, we are still less likely to be able to answer it. In such a case we must make an accurate examination of the form of the wound and compare it closely with that of the weapon. In such cases also the second source of information on which we base our opinion as to the relation of a weapon to the wound may be of use, namely, the examination of the weapon. The presence of blood, hair, cotton or woollen fibres on one of two weapons indicates that this was the weapon used. The presence of blood is particularly to be looked for, and in those parts of the weapon from which it could be washed off least easily. We should further note the condition of the point and edge of the weapon, and if the edge is broken or nicked at all, whether this condition is old or recent. The sharpness of the edge should further be noted, and if the edge is sharp note whether it has recently been sharpened. All these points have a certain bearing on the case. Also the location, shape, depth, etc., of the wound should be carefully noted to see if an accidental fall would be likely to account for it. For these features of the wound may be such that no fall could cause it.

We see, therefore, that in incised and punctured wounds the use of a weapon may not be hard to make out, but that in general the question whether a particular instrument caused the wound is often difficult or impossible to answer. Often the best we can do is to say that the wound could have been produced by the weapon.

IV. Was a Wound Self-Inflicted or was it Inflicted by Another?

In other words, was it *suicidal* or *homicidal ?* Speaking of suicide in general, its most common cause is alcoholism. It is not infrequent in youth. Lutaud[1] states that in fifteen years, presumably in France, there were 1,065 cases of suicide between the ages of ten and fifteen years. This seems to be explicable only on the ground of heredity or of cerebral affections. Among 27,737 cases of suicide, observed in France, the same author gives the following commonest causes in the order of greatest frequence: Drowning, strangulation, pistol-wounds, incised and punctured wounds, poison. The age, sex, and social conditions influence the choice of means. Thus among males drowning is preferred by the young, pistol-wounds by the adult, and hanging by the aged, while among females asphyxia is the favorite method, as there is no pain and no disfigurement.

While many pathologists consider suicide an act of mental alienation, and though such may be the case in a large number or even in a majority of cases, yet in a considerable number it is a voluntary and rationally planned act. The question, Is it suicide or homicide? may be put in all cases of death by cutting instruments, and in many from other kinds of wounds. It is often, if not generally, impossible to answer it with absolute certainty. It is hardly suitable for the medical witness to try to reconstruct the scene of the crime from the medical facts, for he should abstain from everything not medical and should distinguish that which is positively proven from that which is merely probable.

---

[1] Lutaud: "Man. d. Méd. Lég.," 5th Ed., 1892.

Suicides often leave a letter or some such indication to show that the wound was self-inflicted. If such is not the case, the question as to the cause of the wound may or may not be medical. If the question is a medical one, there are certain points to notice as to the wound, such as its *nature*, *situation*, *direction*, and the *number* and *extent* of the wounds, from which we are to form an opinion. There are also other circumstances which furnish evidence and thus assist us in answering the question. This evidence is furnished by the weapon, the signs of struggle, the examination of the clothes and body of the deceased and of the accused, the position and attitude of the body, and any organic lesions, etc., predisposing to suicide.

The **nature** of the wound bears upon the question of the homicidal or suicidal origin in the following way: Most suicidal wounds are incised or punctured wounds. *Incised wounds of the throat* are generally presumptive of suicide, but a homicidal wound may be inflicted here to conceal the source of infliction of the wound. Such a wound if homicidal would imply malice, on account of the attempt at deception and concealment, and would convict the assailant of murder. Unless the deceased was asleep or drunk or was otherwise incapable of resistance, such a homicidal wound can often be distinguished from a similar suicidal wound by the form and direction of the wound, by its irregularity, and by other wounds on the hands or person of the deceased. Taylor[1] mentions a case in which the peculiar form of the wound, like that made by butchers in killing sheep, led to the suspicion that homicide had been committed by a butcher, who was subsequently arrested, tried, and convicted of murder. The *regularity* of the wound has been taken to indicate suicide rather than homicide. That it does so is not questioned, but it is more or less fallacious if resistance is impossible, in which case a murderer may easily make a regular, clean, incised wound here. *Contused wounds* are seldom suicidal, for they are not sufficiently speedily or certainly fatal. They are also more painful and disfiguring. Contused wounds usually indicate murder or accident, though there are not wanting cases of suicide by such weapons as a hatchet or a hammer. There is more difficulty in the case of a contused wound due to a fall instead of a weapon; for here we have to decide whether the fall was accidental, suicidal, or homicidal. The nature of the wound is of little assistance in the case of insane or delirious patients, who may commit suicide in the most unusual and curious manner.

---

[1] "Med. Jurisprudence," 11th Amer. Ed., 1892.

Taylor[1] relates the case of a delirious patient in Guy's Hospital, in 1850, who tore away the whole of the abdominal muscles from the lower part of the anterior abdominal wall. If the case had not occurred in the hospital or where there were witnesses of the deed, the nature of the wound would have indicated homicide except for the delirium. The following case, quoted by the same author, illustrates a wound of very unusual nature and situation, which might have been taken for a homicidal wound with intent to conceal as far as the situation of the wound was concerned. The wound was accidental and occurred in the following way. A girl fifteen years old jumped on to her uncle's knee while he was holding a stick between his legs which she did not notice. The stick passed up her anus, but she withdrew it and went on playing, though she complained of pain. On the following night acute symptoms of peritonitis set in, and she died of it in forty-eight hours. On post-mortem examination a rent was found in the anterior part of the rectum penetrating the peritoneal cavity.

The Situation or Position of the Wound.—A suicidal wound must be in such a position that the deceased could have inflicted it himself. Such wounds are, therefore, generally anteriorly or laterally situated. The "site of election" for suicidal wounds is the neck for incised wounds, and the chest, especially in the region of the heart, for punctured wounds. The situation of suicidal wounds, of lunatics, etc., shows all kinds of fantasies. The mere situation does not suffice to distinguish suicidal wounds, as a murderer may simulate a suicidal wound for purposes of concealment. Some regard a wound in the back as proof against suicidal origin, but it is not so much the situation of a wound as the situation taken in connection with the direction which furnishes the proof against suicide in such wounds.

---

[1] "Med. Jurisprudence," 11th Amer. Ed., 1892.

As a rule, a suicidal wound, besides being in an accessible part of the body, is also in a part commonly known to be rapidly mortal, as the neck and heart. But suicidal wounds are not always in the situation which is anatomically best for being rapidly fatal. Concealed wounds or wounds in inaccessible parts presumptive of murder may be suicidal and so placed to impute them to another and give rise to the suspicion of murder. The blood-vessels of the arms and legs may be selected as the site of a suicidal wound. This situation is often regarded as uncommon, though the writer has met with it in one or more cases of attempted suicide. It is illustrated in the famous case of Abdul Aziz, the Sultan of Turkey. He was found dead under suspicious circumstances with two oblique, ragged wounds at the bend of each elbow, directed from above downward and from within outward. The joint on the left side was penetrated, while only the skin and veins were involved on the right side. Death was due to bleeding from the ulnar artery and the veins. The clothing was soaked with blood and scissors stained with blood were found on the sofa. These wounds were consistent with suicide, though not what would be expected. Nineteen physicians who examined the body agreed in reporting it as suicidal, though one reason given for this opinion, namely, "that the direction and nature of the wounds, as well as the instrument which might have effected them, lead to the conclusion of suicide," was hardly a valid one, for the wounds were not typical of suicide in nature, direction, or position. Such wounds are rarely homicidal, though at least one such case is mentioned.

Suicidal incised wounds, as has been said, are usually in the neck, where they may sometimes be arrested by the larynx, especially if it be ossified, though the incision often divides the larynx. The situation of the wounds is often between the larynx and the hyoid bone, and then meeting no bony resistance, they may divide the great vessels and even nick the vertebræ. But it is rare to be so deep, at least on both sides at once. As a rule, it is deepest on the side on which it is begun and ends more superficially. As far as the situation of a wound is concerned, there is no wound which a suicide can inflict but what may also be inflicted by a murderer. The reverse, however, is not true. We cannot always certainly distinguish between suicidal and homicidal wounds from their situation.

The direction of the wound is one of the most important points to notice. It is considered by some to furnish presumptive evidence for the medical jurist, and taken in connection with the nature and situation of the wound may often lead us to a positive opinion as to the question of the suicidal or homicidal nature of a wound. The evidence from the direction of wounds is only furnished by incised and punctured wounds, rarely by contused wounds. Suicidal incised wounds of the throat are almost always directed from above downward and from left to right if the suicide be right-handed, and in the same direction from right to left if the person be left-handed. Transverse wounds in this situation without obliquity are also compatible with suicide, though perhaps more common in homicide, while obliquely transverse wounds from above downward and from right to left in a right-handed individual are indicative of their infliction by another. Homicidal incised wounds of the neck inflicted from behind or the right side, if the assailant is right-handed, or from the left side if he is left-handed, may have the same direction as similar suicidal wounds. Such a wound may be inflicted by a murderer to deceive as to the cause of the wound by raising the suspicion of suicide. If an incised wound of the throat be inflicted by another from in front, then its direction is usually the reverse of a similar self-inflicted wound.

Homicidal incisions, especially in the throat, may extend at one or the other end beneath the surface beyond the skin wound. In similar suicidal wounds at both angles of the wound the skin is the first and the last part injured, and in such wounds the spine is seldom reached. It should be borne in mind in his connection that a given suicide may be ambidextrous and this fact may be unknown to the friends of the deceased. This is especially the case in the use of the razor from practice in shaving, and the razor is the usual weapon used in such incised wounds of the throat. Neglect of this point may lead to an unwarranted suspicion of murder. The two following cases cited by Taylor[1] well illustrate this fact:

In the case of Sellis,[2] the man was generally supposed to be right-handed, though he was found dead in bed with his throat cut and the razor on the left side of the bed. In point of fact, he was ambidextrous in the use of the razor. The second case, which occurred in London in 1865, was still more remarkable.

A publican was found dead in bed with his throat cut in a left-handed manner. He was supposed to be right-handed and there was bloody water in a basin in the room. His wife, who gave the alarm, had marks of bruises on her, and though she said she had found her husband dead in bed after having left it for a short time, suspicion fell upon her, especially as they were in the habit of quarrelling. The suspicions were removed, however, by the explanation that he had been brought up as a wood-carver, which required him to use both hands equally, and that he had frequently threatened to kill himself, and further that the bloody water in the basin was due to a daughter washing her hands after having touched her father. It is even conceivable that an ambidextrous person, to avoid suspicion of suicide or to impute murder to another, might inflict a suicidal wound from right to left. Notwithstanding all this, the above cases are very rare exceptions, and the rules stated above as to incised wounds in the throat hold in almost every case.

In the case of stab-wounds of the chest, especially in the cardiac region, the same rule as to the direction holds good, and in these wounds we can often define the direction more accurately than in the case of incised wounds. If the suicide is right-handed the wound is regularly on the front or side of the body and directed obliquely from above downward and from right to left, while it is from left to right in case of a left-handed suicide. A murderer from behind, or from the same side with the hand which the victim would use, may inflict a wound in the same situation and direction as a suicidal one. Here again this may be done with the motive of concealment of the nature of the crime. Homicidal stab-wounds inflicted from in front, as they generally are, are usually directed from left to right, and they may be directed from above downward or in the opposite direction. Oblique wounds from above downward may be either suicidal or homicidal; those directed from below upward are almost always homicidal.

---

[1] Taylor: "Med. Jurisprudence," 11th Amer. Ed., 1892.

[2] Willis: "Circumstantial Evidence," p. 97.

When a wound is caused by an instrument both cutting and puncturing, suicide cannot be admitted unless the direction of the wound is compatible with that which the weapon which inflicted the wound, held in the hand of the deceased, might cause. Taylor recommends to place the weapon in the hand of the deceased to see if the direction of the wound could possibly correspond with that which could be taken by the weapon in the hand of the deceased with any position possible for the arm and hand. Therefore certain wounds by position and direction exclude suicide, but if a wound is possibly suicidal it is also possibly homicidal.

Though suicidal wounds vary, the above points are sometimes of real assistance in distinguishing between suicide and homicide, especially if the body has not been moved.

Evidence Furnished by the Number and Extent of Wounds.—Multiplicity of wounds, as a rule, indicates homicide, and indeed the reverse is true in a majority of cases that a single wound points to suicide. There are many exceptions, however, to both statements. Multiple wounds are possible in suicide, and that, too, with different weapons; even drowning or hanging may be resorted to after self-inflicted wounds have failed. If several wounds are found, each one of which or more than one of which may be considered grave, it is usual to conclude that the wounds were not self-inflicted, but the medical expert should not judge too hastily from this fact alone, for most wounds do not kill instantly. Only one of several wounds in a case of suicide is, as a rule, "mortal" in character. This being so, some have asserted that if two mortal wounds are present, especially if one of them is stupefying, such as a wound about the head, such wounds are incompatible with suicide. A definite statement of this kind cannot go unchallenged unless the two wounds are in different parts of the body, and both of such a nature as to be immediately or very rapidly fatal. For all cases of suicide or homicide do not die immediately from wounds commonly called mortal; in fact this may be said to be the exception rather than the rule. We may safely say, however, that if there are several distinct wounds on the throat, each involving the large vessels, the inference is plainly murder.

Several wounds by the same or different weapons cannot therefore be proof of homicide. The case of a lunatic suicide is reported who inflicted thirty wounds upon his head. In a case of homicide with multiple wounds the situation or direction of some one or more of them may give evidence as to the origin of the wounds. Ogston, Sr.,[1] states that especially in the case of incised wounds of the throat a suicide may make a number of small or superficial tentative cuts besides the principal one, but these incisions are all usually parallel (see Fig. 10). In the case of multiple homicidal incised wounds of the throat, on the other hand, the wounds are not parallel, owing probably to the resistance of the victim in the latter case and his remaining passive in the former. In regard to incised wounds of the neck, the extent of the wound has been thought by some to furnish presumptive evidence of suicide or homicide—of homicide if the wounds are deep, of suicide if they are not. While it is true that suicidal wounds of the neck are, as a rule, not very deep, and that they seldom reach the vertebræ and generally do not divide the vessels on more than one side, yet sometimes such wounds are as deep and extensive as homicidal ones. This may imply a determined purpose not to be foiled in the attempt at suicide. Thus Marc reports a case of suicide by an incised

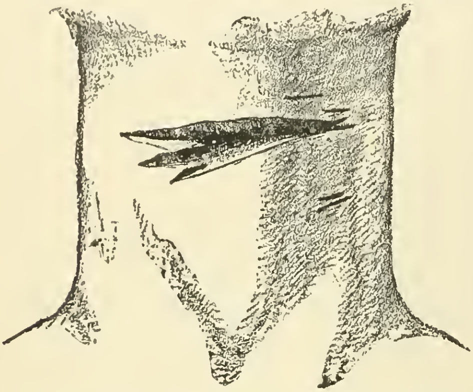


FIG. 10.—Suicidal Cut Throat from Left to Right, showing the Tentative Cuts at the Commencement and the Serrations at the Termination of the Wound.

---

[1] "Lectures on Med. Jurisprudence," p. 424.

wound of the neck, where the wound was so deep as to reach the vertebræ or their anterior ligaments and to divide the trachea, œsophagus, and both carotids and jugular veins. The extent of this wound was greater than in most suicides, but still we can hardly lay down a hard-and-fast rule of much practical value according to which extensive wounds are evidence of murder. Such wounds are, however, presumptive of murder taken in connection with other signs pointing that way.

The question may arise in regard to a wound, *whether the victim wounded himself by precipitating himself on the weapon.* This may be alleged by the defence, but it is difficult to believe if the wound is deep, for the body would naturally repulse the weapon. If the wound is deep the weapon must at least have been strongly held, which may or may not be consistent with the theory of self-defence. If the direction of the wound is oblique from above downward, or if there is one external wound and two separate tracts internally, from a second use of the weapon on the part of the person holding it, then the above allegation is doubtful, if not impossible.

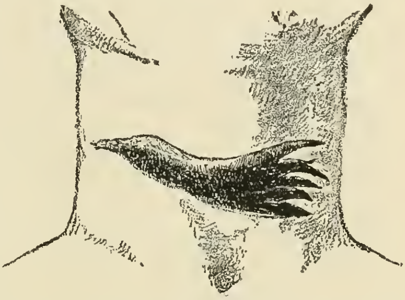


FIG. 11.—Homicidal Cut Throat from Right to Left, showing a Tentative Cut at the Commencement and the Serrations at the Termination of the Wound.

By comparing the relative positions of the deceased and accused, as indicated by the witnesses and the accused, with the position and direction of the wound, we may often judge whether the allegation is possible or probable.

Besides the above points derived from the wound itself, there are several other factors which belong to the category of circumstantial evidence, but which come within the province of the medical expert. These latter points of evidence are sometimes almost as important as the former, and taken in connection with them they help to make the evidence far more conclusive.

Evidence furnished by the weapon as to the origin of wounds.

We have already seen in a former section that we can often tell, by various signs of the wound, with what kind of a weapon it was made. We may thus be able to say that a wound was made by a weapon similar to one exhibited. Also by examination of the weapon itself and from the circumstantial evidence of where and how it was found, we may sometimes say that the wound was inflicted almost certainly with a particular weapon. All this evidence may sometimes be made use of in judging between the suicidal and homicidal origin of a wound.

The POSITION *of the weapon* or the place where it is found is a matter of considerable importance. If it has not been touched, its position should be carefully examined, or inquired about if it has been moved. The presence of a weapon which might have caused the wounds in the hand of the victim is in general proof of suicide. The weapon must not merely lie in the hand, it must be gripped by the hand. One might suppose that the weapon placed and held in the hand until rigor mortis sets in would still be firmly held. Casper says that this is not so, but that the weapon falls from the grasp as soon as the hand is unbound. Also Hofmann's[1] experiments proved the same point. By the use of ligatures and several artificial means he tried to confine a weapon in the hand of a recently dead body so that it would be as firmly held as by a contraction of the muscles during life. These experiments were entirely unsuccessful, for though the fingers remained closed, the object was simply held and not grasped, and fell from the hand on the release of pressure.

In suicide the weapon is sometimes held so firmly that force is required to dislodge it. It seems as if the muscular spasm or grip persists after death, as cadaveric spasm, until rigor mortis occurs and sets it, as it were. The murderer, therefore, cannot imitate this grip, and an unsuccessful attempt to do so would indicate murder. It should be borne in mind that the weapon in the hand of the deceased may have been for the purposes of defence; therefore it is necessary to note whether the wounds on the body correspond to those which could be made by the weapon. Indeed, this fact is most important to note in all cases of suspected suicide where the weapon is found. If the weapon is not in the hand of the deceased, note carefully

[1] See "Med. Leg.," trad. par Brouardel, p. 601.

where it lies. If death is due to a suicidal or accidental wound which is immediately or very rapidly fatal, the weapon is generally found near the body. If so, it is well to note on which side it lies, and if it lies near, whether it has apparently fallen or been thrown or placed there. If the relation of the body and the weapon has been disturbed by moving either, the position of the weapon as found by the medical witness is of little value. In cases of suicide the weapon *may* possibly be found at some distance or even concealed, though this is exceptional. Thus Taylor[1] states that the razor in one instance was found shut at the side of the deceased, who had committed suicide by cutting his throat. In another instance the razor was found in the pocket of the deceased, bloody and closed. As a rule, the weapon is found lying at the side of a suicide if it is not grasped in the hand. If the weapon is far from the body and the wound was quickly fatal, especially if the weapon is hid or cannot be found, it is strongly presumptive of murder. If the weapon is found near the body it is well to note whether the edge is sharp or blunt, straight or bent, or notched, as these points may assist us in forming a judgment as to suicide or murder.

A weapon belonging to the victim may be substituted by the murderer for the one really used, and the former may be placed by the side of the body. Therefore the weapon found should correspond to the wounds as to length, depth, sharpness, etc., to be compatible with suicide.

Generally a suicide foiled in the attempt to take his life uses the same weapon over again if he persists in the attempt. But he may not do so; on the contrary, if the first attempt was made with a knife, the second may be made with a pistol, etc. Several wounds by the same or different weapons cannot therefore be an absolute proof of homicide.

The presence of blood, hair, and other substances on the weapon used, or probably used, is a matter of some importance. Blood is not necessarily found on the weapon used to inflict a mortal wound, especially in the case of blunt instruments. In stab-wounds, too, the vessels may be compressed by the blow or the weapon may be wiped as it were on withdrawal by the elasticity of the skin and by the clothing, except for a thin yellowish film. Thus it is that the first stab-wound shows no blood on the outside of the clothes but only on the inside, while the outside of the second is usually bloody but may be but little so. To make sure whether or not there is blood on a knife or other weapon it is necessary to examine all the depressions on the instrument, as the blade itself may have been washed, and only those traces of blood remain which are less accessible to cleaning by washing. Blood coagulated on a blade indicates, as a rule, blood from a living animal, but it may not do so. Furthermore, it may be hard to distinguish between a thin layer or spots of dried blood not coagulated and coagulated blood which has dried in a similar form.

---

[1] "Med. Jurisprudence," 11th Amer. Ed., 1892.

If blood is not found on a weapon, hair and other substances which can be identified may be. This is especially the case with blunt weapons, on which, as we have seen, blood usually fails. A fragment of the weapon may break off in the wound, as in stab-wounds, and may be identified as belonging to one in the murderer's possession.

The signs of a struggle furnish important evidence, as they are not likely to be found in the case of suicide. If the wounds were inflicted by a cutting instrument, the existence of a struggle may be indicated by incisions on the palm of the hand or fingers or on the dorsum (see Fig 12). Such wounds would not be self-inflicted and would indicate a struggle with the murderer. Or if contusions or ecchymoses indicating the form of the foot, fist, fingers, or finger-nails are found on the face, neck, chest, forearm, or hand of the deceased, this again indicates a struggle with the assailant, and goes far to prove murder. The same is true of the imprint of a bloody or dirty hand on the clothes of the victim when the victim's hands were not bloody. Also such an imprint in a position where the deceased could not have reached with the particular hand indicated, as is the case if the impression of a right hand be found on the victim's right arm, indicates a struggle with a murderer, etc. In one case of murder, on the back of the left hand of the deceased there was found the bloody mark of a left hand evidently not that of the victim himself. The presence of marks of violence about the mouth of the deceased, done to close it to prevent the victim from giving an alarm, especially if surprised during sleep, is presumptive of murder. Sometimes hair or fragments of clothing belonging to the accused are found in the grasp of the deceased, indicating a desperate struggle, and they are very suspicious of murder. Thus Taylor[1] cites the case of a murder trial in Ireland, in 1877, where hairs found firmly grasped in the hands of the deceased were found to correspond to the hair of the accused. The clothes of the deceased, as well as those of the accused, often indicate a struggle unless the accused can satisfactorily account for the condition of his own clothes in some other way.

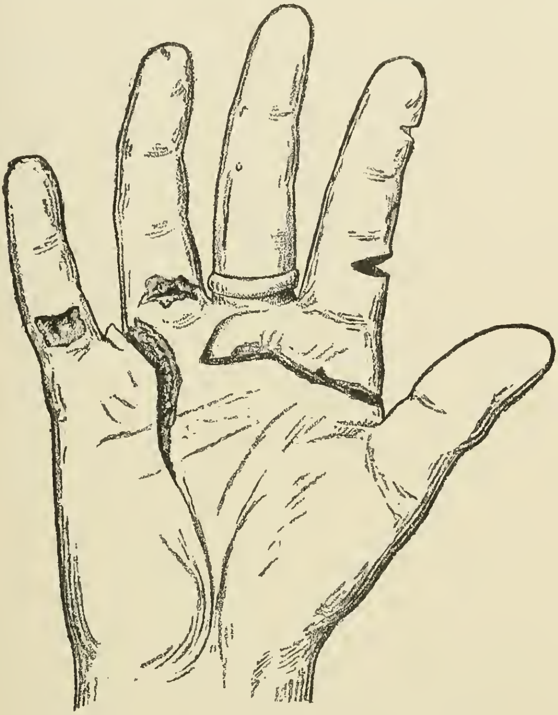


Fig. 12.—Incised Wounds of Right Hand in the Struggle of Defence. Homicide.

The examination of the clothes and body of the deceased and the accused may furnish important evidence.

If suicide is accomplished by a weapon like a knife, it is rare for the hand not to be bloody. If it is not bloody in a case of supposed suicide suspicion is at once aroused. The presence of blood on the hand does not prove suicide, though its absence may disprove it, as the hand is generally bloody in case of murder by being carried to the wound.

---

[1] "Med. Jurisprudence," 11th Amer. Ed., 1892.

The *examination of the clothing of the deceased* is of great importance. As we have noticed before, a suicide generally opens them, a murderer rarely. A suicide is often partly or even wholly undressed when he inflicts the wound, while murder is usually committed on those entirely dressed. The wound of the clothes should correspond to that of the body in case of murder. In suicide the wounds of the body and of the clothes may not correspond, especially if there exists a motive to falsely impute the crime. The clothes of the deceased as well as those of the accused may indicate a struggle, as we have already noticed. Of course, in regard to the clothes examined, it is necessary to clearly prove that they were worn at the time by the deceased or accused, otherwise serious mistakes may be and sometimes are made. In examining the blood-spots on the clothing, note whether the blood occurs in large patches or sprinkled as by a spurting vessel.

The *body of the accused* may present scratches, marks of nails, contusions, bites, or other wounds indicative of a struggle. It would be well to ask the accused how he received the wounds or scars, to see if his explanations tally with the injuries. It is hard to tell when wounds which have cicatrized were inflicted; we can only distinguish between old and recent ones, and thus control the statements of the accused. An examination of the finger-nails of the prisoner soon after the crime may reveal blood underneath when the rest of the hands and person are free from it. Note also the site and shape of the blood-spots, if they exist, and whether or not they came from an arterial jet. These spots may be on the body or clothes of the accused. The account of the accused as to these spots may or may not correspond to the facts as indicated by them. The above leads us to the more or less important question:

Could the Assailant have Escaped without Stains?

It is possible for the murderer to escape without being spotted with blood, but the probability of this occurrence depends on the nature of the wound and the relative positions of the deceased and the assailant at the time the wounds were inflicted. This latter fact is very largely, if not altogether, a matter of speculation as far as the medical evidence goes. It is a popular, though false, idea that a murderer's clothes must be bloody, and the police may be misled in expecting to find them so in every instance. Taylor[1] cites several cases in which either no blood was found on the murderer's clothes, or only small spots wholly out of proportion to the amount of blood which must have spurted or flowed from the wound. Absence of blood on the prisoner's clothes is often made use of by the defence to prove the prisoner's innocence, whereas, besides the possibilities of having had no spots in the first place, the clothes may have been changed or washed before the examination was made. This has occurred in more than one murder trial. Taylor[1] mentions the following cases in illustration:

It was alleged that the absence of blood-stains on the prisoner's clothing was a strong proof of his innocence in the trial of Sub-Inspector Montgomery for the murder of Mr. Glasse (Omagh Ass., July, 1873). In this case the weapon was a bill-hook which had produced contused wounds on the head. There was blood on the floor about the body, but the wounds were not likely to have been accompanied by much spurting. Yet it was assumed that the assailant in this case must have been covered with blood. Much stress was laid upon the absence of blood-stains. On the first two trials the jury could not agree, owing chiefly to the absence of blood-stains, but on the third trial he was convicted and afterward admitted that he had removed the blood-stains from the clothes with cold water. Also in the case of Reg. *v.* Courvoisier (C.C.C., 1840) the accused, who was tried for the murder of Lord William Russel, had no blood-stains on his clothes. All the vessels of the throat of the deceased had been cut to the vertebræ while he was asleep. It was contended most strongly that the accused could not possibly have committed the crime, as he had no blood-stains. But after conviction he confessed that he wore no clothes when he committed the murder, and he only had to wash his hands and the carving-knife he used. Again, in the case of Reg. *v.* Thompson (Durham Wint. Ass., 1863) the defence mainly relied on the absence of blood on the prisoner's clothing. The wound in the throat of the wife of the accused was five inches long, directed from left to right, dividing all the vessels and nerves of the neck. The medical witness stated justly that no such wound could be self-inflicted. It was rapidly fatal. No weapon was found near the body. The prisoner was convicted.

---

[1] "Med. Jurisprudence," 11th Amer. Ed., 1892.

The same author cites the case of a prisoner on whose trousers worn soon after the murder no blood-marks were found, but the trousers actually worn by him were found with blood upon them. Juries have even acquitted the prisoner apparently only because no marks of blood were found, though the other circumstances were explicable only on the theory of murder.

It should be remembered in this connection that blood-stains may be found on the clothing of many, especially on the coarse clothing of working-people. This may be accounted for by the occupation, flea-bites, accidental circumstances, or it may occur without definite explanation. Such persons may be accused of murder and yet the blood-stains be consistent with innocence. Too much importance should not, therefore, be attached to them, even if the accused cannot satisfactorily explain them, if he does not attempt to do so in a suspicious way. That blood on the clothing even under suspicious circumstances may be consistent with innocence is illustrated by the case of a suicide cited by Taylor,[1] in which the throat was cut. In this case the son first found his father dead, and thought that a blood-vessel had ruptured. He raised the body, staining his hands and clothes, then went for help. At the inquest he was closely questioned as to the presence of the blood-stains, but there could be no doubt that the case was one of suicide.

In general, we may say that a murderer is much more likely to escape without blood-stains in contused and punctured wounds than in incised wounds, for in the former classes the bleeding is much less free and is less likely to spurt from the wound. In the case of incised wounds he is most apt to escape without stains if he is behind or to the side of the victim when he inflicts the wound—in other words, when a part of the body of the deceased was between the assailant and the wound inflicted. Furthermore, the assailant is more likely to escape without blood-stains if there is a single wound than if there are several, and each additional wound makes it more likely that he will be spotted with blood.

[1] "Med. Jurisprudence," 11th Amer. Ed., 1892.

The *examination of the ground or floor and the furniture*, etc., may furnish some evidence as to the nature of the crime, and also help the witness to answer the questions which may sometimes be asked, *i.e.*, AT WHAT SPOT WAS THE VICTIM WOUNDED? and WHERE DID HE DIE? This question is sometimes settled by examination of the spot where the deceased lay and the furniture, etc., about. Sometimes the floor or ground and the furniture or surrounding objects give the requisite evidence. The examination of the cracks and corners of the floor and furniture should not be neglected, and Taylor instances a case where the hair of a dog helped to clear up the case. If the body has not been disturbed the most blood is usually found where the deceased died. If the victim succumbs at the spot where he was wounded, blood is found only in the immediate neighborhood, except for arterial jets, which may be as far distant as two metres. The separate blood-spots of an arterial jet are circular if the jet strikes the object perpendicularly, oval or wedge-shaped with the larger end away from the body if it strikes the object obliquely.

If the blood-stains are more diffused and are found in other places, careful notice should be taken as to whether the different places communicate with one another by traces of blood. If they do not communicate, it goes to show that the body was moved after active bleeding had ceased, that is, after death, but this indication is not absolutely positive. If traces of blood do connect the larger blood-spots, it is of interest and importance to know where the deceased was wounded and where he died, also whether he moved or if he was moved before or after death. This question is not always capable of solution. Some injuries exclude the possibility of active motion. Stupefying contused injuries of the head or an incised wound opening a great artery are both inflicted where there is the greatest hemorrhage, and the spot where the deceased was wounded and died should be identical. In such cases a second large spot of blood, connecting or not with the first wound, indicates that the body has been moved. But if the wound does not bleed much or rapidly, the wounded person may fall at a distance from the spot where he was injured, and death occurs, as a rule, where there is the greatest amount of blood; for a certain amount of bleeding occurs for a short time after the victim falls or even after death. One can find in many places the signs of arterial jets marking the movement of the deceased from one blood-spot to another. This is quite different from the tracks caused by dragging a bleeding body. All this it is important to notice, for the dragging or passive moving of the body strongly indicates murder. Blood at a distance may indicate the occurrence of a struggle, or that the body was moved, or it may show the tracks of a murderer. As to the latter point, *the imprints of the hands and feet*, whether bloody or not, may indicate murder and establish the identity of the murderer. We have already seen how they may occur on the deceased and indicate a struggle, and thus be presumptive of murder. When the marks are made by the naked foot, it is well to examine it by lining it off in squares, so as to compare it with the imprint of the foot of the accused. Simple inspection can sometimes give the required evidence. We may even get an impression of such imprints in the snow. Imprints of the boots or shoes worn by the accused compared with those imprints found at and near the scene of the crime may sometimes help to clear up the case, but this may perhaps be considered outside of the sphere of the medical witness. Such and other signs of a struggle about one of the blood-spots would indicate that the wound was received there, though death may have occurred at another spot. In such a case it would be well to examine to see if there was much blood where the body was found, for if there was not it would indicate that the body had been moved there after death, and thus be strongly presumptive of murder.

As furnishing some evidence which may help to distinguish between suicide and homicide in the origin of wounds, the question may be asked, WHAT WAS THE POSITION OF THE VICTIM WHEN INJURED OR DYING? and also, WHAT WERE THE RELATIVE POSITIONS OF THE VICTIM AND ASSAILANT?

The position of the victim at the moment of the injury is sometimes indicated by the position of the wound, the direction of its tract, and the direction from the wound of the blood on the body and clothes. On the neck or extremities the course and form of the wound may indicate the position of these parts when the wound was inflicted, for sometimes in flexions of these parts the skin lies in folds, and a wound inflicted when these parts were so flexed would be irregular, wavy, or zig-zag.

Further, the position and movement of these parts necessary to restore directness to the wound may indicate the position of the parts when the wound was inflicted. The examination of the relative positions of the wound in the clothes and the body may help to indicate the position of the body when wounded. The position of the blood on the body and the direction of the blood from the wound, whether below or at the sides, etc., tends to show the position of the body when bleeding. Thus if the body was at any time in the erect position, some of the blood-stains will be vertically below the wound, or if the victim was lying on the back then the stain would be at the sides only and not below the wound, except such stains as indicate that they were produced by arterial jets. Few suicides cut the throat in the recumbent position; therefore it may be considered in the light of an indication of homicide if the blood-stains show that the victim was not erect after the wound was inflicted. It is well also to note the form, direction, and obliquity of the blood-spot. This would indicate, by comparison with the wound, the relative position of the wounded person and the blood-spot, and thus show whether the body had been moved or not, as, for instance, by the murderer for the purpose of robbery. The force of the bleeding is also indicated by the form of the spot, and this would indicate how rapidly death probably ensued. This fact might thus help us to judge whether the victim probably died where he was wounded, and whether other and remote blood-spots would not be presumptive of murder. If the victim is found in night-clothes, this fact would tend to show that he was lying down when wounded. The medical evidence as to the position of the victim when injured is, therefore, circumstantial and not very positive; that in regard to the *relative position of the victim and assailant* is even less positive. We presuppose in this question that the case is one of murder. We are not to prove murder or refute suicide. We can rarely be *positive* as to the relative position of the assailed and the assailant. A wound in the back may be caused by some one in front with an arm behind. The direction of the wound would indicate this, for if the assailant is right-handed and inflicts a wound on the back from in front, a stab-wound would almost always be directed from left to right, an incised wound from right to left, both from above downward. With a left-handed murderer the direction would most likely be from right to left and from above downward for a stab-wound, and from left to right and from above downward for an incised wound. If the assailant were at the back of the victim and wounded him in front, the direction of these wounds would be the opposite of the above, *i.e.*, from right to left for a stab-wound and from left to right and from above downward for an incised wound with a right-handed assailant and *vice versa* with a left-handed assailant. These wounds occur more commonly than those of the back, and are especially noticeable in incised wounds of the throat. In the case of these incised wounds of the throat inflicted from behind, the direction from left to right and from above downward resembles that of self-inflicted wounds in the same situation. As a general rule, wounds are on the same side of the victim that the assailant was; the facts given above help to show us the exceptions. Thus a wound on one side is presumptive that the murderer was on that side, or possibly at the front or back and only exceptionally on the opposite side. The presence of wounds on one side only may help to confirm the testimony of a witness that the victim was against a wall or some other obstacle which protected the other side. The question of the relative position of the combatants in duels and the nature of the weapons used as shown by the wounds has sometimes come up, especially in other countries, to determine whether the combat was regular and fair.

In all cases of suspected suicide, but where a doubt exists between suicide and murder, or even accident, *hereditary disposition and organic affections* of the body, such as alcoholism, incurable or painful diseases, chronic inflammation of the brain and meninges or of the genito-urinary organs—may support the idea of suicide.

Imputed or Self-Inflicted Wounds.

Closely allied with the question of the suicidal or homicidal origin of wounds is the question whether a wound imputed to another is self-inflicted or inflicted by another. These wounds are seldom fatal. In discussing the question whether a wound is self-inflicted or inflicted by another, we have referred occasionally to suicidal wounds where the circumstances were such as apparently purposely to imply murder and impute the cause of death to some one else. This happens more often in cases of unsuccessful suicide. Here we have recourse to the same evidence that we have gone over in the present section which helps to distinguish between a suicidal and a homicidal wound. The case may be somewhat more difficult, as the unsuccessful suicide may manufacture evidence against the accused and hide to some extent the evidence of suicide. These cases can usually be decided, however, in connection with the circumstantial and other evidence. The majority of cases of imputed but self-inflicted wounds are very superficial, often not below the true skin. Being self-inflicted they have many of the characters of suicidal wounds. Thus they are usually situated in front and on the left or right according as the wounded person is right or left handed, and the direction is usually similar to that in suicidal wounds. Such wounds are generally incised or punctured wounds, seldom contused wounds, and in this respect they resemble suicidal wounds. As exceptions to this rule, Bergeret[1] mentions some cases where females in attacks of hysteria have inflicted severe contusions on themselves, and have preferred charges of attempted murder against innocent persons. Like suicides also the hands are seldom injured, though they may be much so in resisting homicide.

In other respects, however, these wounds differ from suicidal wounds. Thus they are not usually situated over a "mortal" spot, and they are often numerous and *scattered*, sometimes parallel and sometimes not. The wounds in the dress do not correspond even as often as in suicide. In comparing cuts in clothing with those on the body, it is important to find what articles were worn at the time the assault was alleged to have taken place, and to make sure that the clothes examined were those worn or alleged to have been worn. It may not be necessary that the clothes examined should have been really worn, for if they were alleged to have been worn and were not, the examination of them will almost always show the deception or the self-inflicted nature of the wounds. Then take careful note of the position, direction, form, and size of the cut and the apparent sharpness of the weapon in the several layers, and see if they correspond with one another and with the wounds on the body in those various particulars. In imputed wounds the clothes are generally cut when off the body and can seldom be done so as to deceive a careful examiner. Several wounds cannot exist in the same region of the body without some being bloody and showing the marks of it on the clothes. Even a single wound of the clothes generally shows blood on the inner surface if there is a corresponding wound of the body underneath. In simulated and imputed injuries the blood-stain may be on the outside of the clothing instead of on the inside, showing that it was artificial and not natural. An impostor may either do too much or too little, and the medical witness should be on guard against both alternatives. Taylor[1] mentions a case which occurred in London some time ago, in which there were *two* cuts in the shirt near together exactly alike in size, form, and direction, making it evident that the weapon had gone through a fold of the shirt. This proved that the shirt could not have been worn at the time it was cut, for if the shirt was folded while on the body the weapon must have gone through the fold and then through another layer of shirt, making three cuts instead of two, or five instead of four, before it could have reached the body. This and other facts made self-infliction of the slight wound on the chest probable. The same author cites another case showing the imperfect manner in which the cuts in the clothes are made in imputed wounds, the clothes being off the body at the time. The case occurred in Nottingham in 1872, the accused being charged with wounding the plaintiff on the highway by stabbing him in the arm, though there was no robbery or other motive for the act. The coat and shirt sleeve were found cut, but there was no corresponding cut in the lining of the coat sleeve. The charge was clearly false, and was trumped up by the youth who was the plaintiff because he wished to leave the place where he had been sent for private study.

---

[1] Ann. d'Hyg., 1863, t. 1, p. 463.

In examining a case where the self-inflicted nature of imputed wounds is in question, the following are some of the many points to keep in mind in the examination and to be ascertained by the examination: (1) The relative position of the plaintiff and the assailant at the time of the alleged attack.

---

[1] "Med. Jurisprudence," 11th Amer. Ed., 1892.

This can be compared with the position as stated by the plaintiff or other witnesses. (2) The situation, direction, depth, nature, and number of the wounds. (3) The situation and direction of blood-marks or wounds on the dress or person of either or both. (4) The marks of blood and the quantity of it at the spot of the alleged struggle. (5) The signs of a struggle and the various other points of circumstantial evidence gone over in considering suicidal and homicidal wounds.

Though a severe blow may cause a slight mark, it does not follow that a slight mark implies a severe injury, else the exception is made the rule. The inconsistency of the story of the plaintiff is generally so palpable that imposture is evident, but prejudice and unjust suspicion are often excited against those accused. Thus Taylor[1] states that "a strong suspicion was raised against the then Duke of Cumberland, in 1810, in reference to the death of Sellis, when a skilful examination of the wounds on the deceased would have shown that they might have been self-inflicted." The same author also cites the case of M. Armand, a merchant of Montpelier, who at Aix in March, 1864, was tried for an alleged murderous assault on, or imputed murderous strangulation of, his servant. The excoriation on the back of the neck was so slight as to escape the observation of some medical men, and it was evidently self-inflicted, either accidentally or purposely, as the facts showed. The assertions of a number of medical men were taken by the court to support the servant's story to the effect that his master had struck him a severe blow on the back of his neck, rendering him insensible for many hours from concussion of the brain. The evidence given chiefly by Tardieu for the defence showed the story of the complainant to be a fabrication, and the accused was justly acquitted.

WAS A WOUND ACCIDENTAL?

In answering this question we must distinguish accidental wounds from those self-inflicted and those inflicted by another. These three classes comprise all wounds. In case of a trial for murder it may be alleged by the defence that the wound was caused by accident or that it was due to suicide from a fall, falls being a common class of accidental wounds. So we have to judge between accident on the one hand and homicide and suicide on the other hand. The question arises especially in cases where the injury causing death is one commonly due to accident.

---

[1] "Med. Jurisprudence," 11th Amer. Ed., 1892.

As to the QUESTION BETWEEN ACCIDENTAL AND SUICIDAL WOUNDS, they are often easily distinguished, especially if the body has not been disturbed. In suicide there is clear evidence of design, and the circumstantial evidence helps to make the case clear. It may not always be possible to decide, however, as an accidental wound may sometimes resemble a suicidal or homicidal one. Accident is often shown by the *nature* of the wound. Thus it is rare for an accidental mortal wound to be caused by a knife or similar weapon held in the hand and forced into the body by a fall, the blow of an opening door, etc. But such exceptional cases have been reported. Incised and punctured wounds are, therefore, very rarely accidental, and most accidental wounds are contused wounds or contusions.

Again, accident is often shown by the *situation* of the wound, which should be on an exposed part of the body unless the accident is due to a fall from a height, when the wound may be almost anywhere. But such injuries are easily shown to be due to falls. The fall, of course, may be accidental, suicidal, or homicidal. Some wounds in exposed parts forbid accident on account of their nature, *i.e.*, deep incised wounds of the throat. If the deceased has a life insurance, suicide is less probable, as the insurance is often not paid in case of suicide. In fine, accidental wounds are distinguished from suicidal by—(1) Their *nature;* accidental wounds are almost always contused, suicidal very rarely so, only in cases of lunatics and delirious persons and where suicide is accomplished by a fall. (2) The situation of the wound or wounds indicates their origin. We have already studied the situation of suicidal wounds and have also seen that accidental wounds are only on exposed parts, except when the injury clearly indicates a fall from a height. The evidence from the direction of wounds rarely applies, as this is valuable only in incised and punctured wounds, which are seldom accidental. Both kinds of wounds are usually few in number except in case of a fall from a height or a crush, though sometimes suicidal wounds are multiple.

The evidence of the use of weapons points strongly to suicide. The signs of a struggle are hardly consistent with either suicide or accident. The only case in which they might occur would be where a struggle occurred to prevent a suicide from throwing himself off a height or before a vehicle or a railway train. In such a case accident would be excluded by the signs of a struggle, and the question would lie between homicide and suicide. The examination of the clothes of the deceased would furnish no evidence unless some letter or paper were found stating the purpose of committing suicide. Little or no evidence would be furnished by the position of the body when found in cases which might otherwise be doubtful. Organic lesions or other facts predisposing to suicide would furnish presumptive evidence against the wounds being accidental. Of all these various points the first, as to the nature of the wounds, is by itself the most valuable and conclusive. But this gives us no assistance in clearing up a case where it is doubtful whether a fall from a height or a crush by a vehicle or railway train was accidental or suicidal. Some of the other points mentioned may aid us in such a case, and also the fact that such injuries are far more often accidental than suicidal. But in these cases, also, certain circumstances may show that the fall was not the result of accident.

Accidental wounds are generally caused by a fall or a crush, and the fact of their accidental character is generally established by the circumstances of the event. Certain accidental wounds present characteristics which allow the true nature of the wounds to be determined. But in some cases a suspicion may arise and the question may be asked as to WHETHER THE WOUND WAS ACCIDENTAL OR HOMICIDAL. For instance, if a person receives fatal homicidal injuries, and just before or after death the body is thrown from a height or is run over and crushed, it may be hard to determine the murderous element among the many wounds. This is the case if the homicidal wounds were contusions or were caused by blunt instruments, but rarely, if ever, if they are incised or punctured wounds or both. But even in the former instance, a close examination of the lesions and of the locality of the injury can often clear up the case. Thus in a case mentioned by Vibert,[1] as cited by

---

[1] Vibert: "Précis de Méd. Lég.," 2d Ed., 1890.

Hofmann after Taylor, a woman was found dead at the foot of some stairs in a cave. She had died of a fracture of the skull and of the spine, produced by the fall. But about four or five feet above the level of the top step there was found on the wall the fresh marks of an arterial jet of blood. Examination showed a wound in the right temporal region which had opened the temporal artery, and it was therefore thought that the woman was wounded at the top of the stairway and then thrown down, which was afterward proved to be true. In another case, reported by M. Tourdes, a man knocked down and killed by an axe, which crushed his skull and caused the brain to exude, was placed in a road frequented at night by heavy wagons. The head was placed in the rut, but the coagulated blood and brain formed a puddle which did not appear on the wheels or their track, and no bloody furrow was caused by their passage. The same author mentions the case of a woman plainly strangulated by the hands and then thrown into the ditch of the fortifications of Paris.

It is especially with regard to fractures of the skull that the question often comes up as to the accidental or homicidal nature of the injury, as to whether it is due to a fall or a wound. Sometimes a depressed fracture may show the form of the instrument. An extensive comminuted fracture of the skull may indicate greater violence than would be received from a fall from the little height which the circumstances may allow. As to the slighter degrees of fracture, the disposition of the fracture itself often shows less than the form and site of the ecchymosis, the lesion of the scalp, and the place and position of the body when found. In such cases the traces of a struggle, the existence of other wounds, etc., may be of great importance. In distinguishing between homicide and accident, as in distinguishing between the latter and suicide, the most obscure and difficult cases are those where the injury has been caused by a fall from a height or by a crush.

This is illustrated by the case of Madame de Tourville, which is quoted by Taylor.[1] She was killed in July, 1876, by a fall from a precipice. Her husband, a lawyer, was accused of murder committed by pushing her over a precipice in the Stelvio Pass. The place where her dead body was found was at a considerable depth below, and the injury was chiefly in the head, which had been crushed by the fall. The body showed no evidence of intentional violence. The prisoner's guilt was established on the following points: (1) The false and inconsistent statements made as to the occurrence; (2) the marks of the body having been dragged some distance so that a part of the dress was found, in a bloody condition, some distance from the body; (3) there were marks of blood on the prisoner's hands and clothing. After a long trial he was convicted, though the sentence was afterward commuted to imprisonment for life. Of course, as we have already stated, if a person is responsible for a fall he is also responsible for the results of the fall. This applies to many of the contused injuries and deaths from falls in prize-fights and drunken brawls.

---

[1] "Med. Jurisprudence," 11th Amer. Ed., 1892.

We may sum up the points of evidence which help us to distinguish between an accidental and a homicidal injury much as we did when the question lay between accident and suicide. (1) The evidence from the nature of the wound is not quite so conclusive as when the question lies between suicide and accident. For contusions and contused wounds are far more often homicidal than suicidal, and accidental wounds are almost always of this class. If, however, the wounds are incised or punctured, this fact points almost certainly to homicide. (2) As to situation, a homicidal wound may be situated almost anywhere; an accidental wound, except in falls from a height, only on an exposed place. (3) The direction of the wound can seldom help us in the case of contused wounds which, practically, are the only ones in question, though it may possibly be incompatible with accident. (4) As to the number of wounds, homicidal wounds are far more apt to be multiple either in a small area or scattered in such a way that an accident could hardly account for them all. (5) A weapon may give evidence more often here than when suicide is in question, for a weapon may be used to inflict contused wounds which may resemble those received in a fall. The evidence furnished by a weapon or blood, hair, etc., on the weapon, etc., is strongly in favor of murder. (6) The evidence from a struggle is also more important because it is more often found. A struggle may occur in homicide, and only in homicide, as a rule, so that signs of a struggle are strong evidence of murder and against the idea of accident.

(7) The examination of the clothes and body of the deceased may give valuable evidence, showing, as it may, signs of a struggle or other marks of an assailant which indicate murder. (8) Examination of the position and attitude of the body and of the spot where it lay and the ground around may furnish more or less proof of murder, as in the case quoted above. Thus the track of the murderer may be discovered or the body may have been interfered with and moved or robbed, all indicating homicide.

In any case, whether it is desired to distinguish accidental from suicidal or homicidal wounds, those cases present the most difficulty which result from falls from a height or crushes. But, as the case of Madame de Tourville shows, the above given and other circumstances may often show even then that the fall or the crush was not the result of accident.

Falls from a height may, therefore, be the result of suicide, homicide, or accident. The injuries are similar in all three cases. A fall of six to eight metres causes, as a rule, numerous lesions, and shows such a traumatism that the case usually excludes the possibility or, at least, the probability that the wounds resulted from blows. Sometimes, however, the gravity of the lesion is not proportional to the height of the fall. Thus Vibert[1] relates the case of a man, afterward employed for several years in the École de Médicine, who jumped from the top of the column of the Bastile, a height of fifty metres. He rebounded on to some canvas stretched at the foot of the monument, then fell to the ground, and was able to get up and walk away. Curiously enough, he killed himself later by jumping from the top of an omnibus in motion. In the case of falls from a height, it is especially true that with grave lesions internally the skin may be intact or only slightly ecchymosed or eroded, or the ecchymosis may be only deeply seated so as not to appear superficially. In the latter case, if life had continued the ecchymosis might have shown itself at some spot on the surface in a few days, but these falls from a height are fatal as a rule. In falls from a height, besides ecchymoses, which may occur where there are no other injuries or may fail where there are many injuries, the *lesions* consist of fractures of bones and ruptures of internal organs, with or without surface wounds. The *fractures* may be of a number of bones, and especially of those which first touched the ground, though the skull may be fractured at some part whether or not it was struck in the fall. These fractures are often comminuted, especially fractures of the skull and pelvis, and when the fall is from a great height. Ruptures of muscles may occur with the fractures.

---

[1] "Précis de Méd. Lég.," 2d Ed., 1890, p. 264.

Ruptures of internal organs are not rare in such cases. According to Vibert,[1] the order of frequency of rupture of the various organs is as follows: liver, spleen, kidneys, lungs, heart, stomach, intestines, bladder, brain. Rupture of the liver occurs especially on the anterior and inferior surfaces and the bleeding is rather abundant. The healthy spleen does not rupture readily, except from a severe traumatism, but if it is hypertrophied it may rupture spontaneously from muscular violence. The lung may be ruptured internally without showing the rupture on the surface and with the ribs intact. Two such cases are mentioned by Vibert,[2] and he refers to others mentioned by Nelaton and Holmes. Rupture of the brain without fracture of the skull is very rare, though cases have been observed and reported, among others by Casper-Liman. In falls from a height the rupture of the aorta, mesentery, diaphragm, and larynx have been noted. It should be remembered in this connection that rupture of the liver, intestine, bladder, etc., may be caused by contusions without sign of violence externally, and such cases cannot, therefore, be attributed to falls unless there are other signs of the latter.

In *crushes* caused by a heavy vehicle, the lesions resemble in many respects those due to a fall from a height. Thus we find fractures and internal ruptures, but we more often and regularly find subcutaneous ecchymoses and ecchymoses between the muscles. The skin is often stripped up extensively and the injuries are generally limited to the region injured. It is rare to find that the cause of the injury leaves no trace on the skin, for it usually gives the form to the erosions or ecchymoses. Sometimes, for instance, the marks of a horseshoe are clearly visible. Ruptures of internal organs may occur here too when there are slight external marks of violence or even none at all. Thus Vibert[1] relates the case of a man with the head crushed, but with no signs of injury to the trunk save a few erosions at the level of the sternum, who had not only rupture of the kidneys, the liver, and the spleen, but also of the lungs and of the heart. In the heart the apex was completely detached and floating in the pericardium, which was intact. There was no fracture of the ribs nor subcutaneous or sub-muscular ecchymoses. The age of the subject was thirty-two, so that the costal cartilages were not probably ossified, which may have accounted for the absence of fracture of the ribs.

---

[1] "Précis de Méd. Lég.," 2d Ed., 1890.

[2] "Précis de Méd. Lég.," 2d Ed., 1890, p. 246.

Crushes by the fall of heavy weights resemble the latter class of crushes, and differ from falls from a height in the fact that the wounds are usually limited to one region. The lesions themselves are more or less similar. Similar internal lesions may be caused by the compression of the chest and body by the knee of a murderer, which may occasion rupture of the internal organs, fractures of ribs, etc. Thus, too, from the pressure of a crowd the ribs may be fractured and the lungs injured. It is particularly in these cases of injury from crushes or falls from a height that we may have most difficulty, as far as the medical evidence goes, of distinguishing between accident, suicide, and murder. But the various points and considerations mentioned above will sometimes enable the medical witness to clear up the case. In some cases the non-medical evidence, circumstantial and otherwise, may be sufficient of itself, or at least in conjunction with the medical evidence.

In falls from a less high place the difficulty is somewhat different, for here there may arise the question between a fall and a contusion or contused wound, and the question generally lies between accident and murder, or, very rarely, between accident and suicide. We have referred to both of these questions above, and from the facts mentioned the case can often be solved.

OF MORE THAN ONE INJURY WHICH WAS THE FIRST INFLICTED?

We can sometimes tell the order in which wounds were received, but the question is rarely answerable with certainty.

---

[1] "Précis de Méd. Lég.," 2d Ed., 1890.

If one wound is mortal and one or more are not, whether the wounds are suicidal or homicidal, it has sometimes been considered that the former must have been inflicted last. But we cannot admit that as a general rule the most grave wound was the last inflicted. For the murderer or suicide, especially the former, may go on wounding after the infliction of a mortal wound, especially as it is the exception, and not the rule, to die instantly after a mortal wound. Several assailants may have inflicted wounds at the same time, which would still further increase the difficulty. The question might then arise, Which assailant had inflicted the mortal wound or which had first inflicted a mortal wound? Under such circumstances, it would not be easy to give a specific answer. There are several signs which may indicate which wound was first inflicted in certain cases. An instrument may become duller or even bent or twisted after and on account of the first wound, and the subsequent wounds would vary accordingly. The wound of the clothes corresponding to the first stab-wound may be and often is only bloody internally, while the second and following wounds are bloody on both sides. The following case quoted by Taylor[1] from the *Annales d'Hygiene*, 1847, p. 461, illustrates this point. A man received three stabs from an assailant, one in the back at the level of the eighth rib, traversing the lung and heart and causing rapid death, and two on the left elbow, cutting the coat and shirt but only grazing the skin. The first one was evidently the first inflicted, for both the wounds in the clothing on the arm were bloody externally at the edges, although there was no blood effused here. The correctness of this opinion was confirmed at the trial.

The point of a knife arrested and broken off in a bone may show that this was the last wound. The amount of bleeding may show which was the first wound. Thus if several severe wounds have been inflicted, all or several of which would naturally cause profuse hemorrhage, and one showed signs of such hemorrhage while another did not, the former would be likely to be the first wound inflicted. Or if one showed slight hemorrhage where much would be expected, this fact would indicate that it was one of the last inflicted. The absence of the signs of spurting blood may tell which of two or more fatal wounds were first inflicted, for this would indicate that this wound was inflicted when the heart action was weakened by loss of blood or even after death, and the other wound or wounds which did not present this sign would have been the first received. In fact, if any of the signs are present about a wound which we have seen to indicate that a wound was inflicted at any time after death, this would show that this wound was not the first received, and that the other or others were inflicted earlier.

---

[1] "Med. Jurisprudence," 11th Amer. Ed., 1892.

Questions as to the CONSEQUENCES of WOUNDS NOT FATAL may often be brought up in civil actions for damages. In certain countries the question of the consequences as to *incapacity* may determine whether an injury shall be the ground of a criminal as well as of a civil action. Thus in France an injury which involves an incapacity of twenty days or more subjects the assailant to a criminal action. The term "incapacity" in this instance refers to general incapacity and not to incapacity for fine and professional work. The latter, however, comes in under the civil action which may be instituted against the assailant or those directly or indirectly responsible for the injury. The amount of the incapacity, its causes, whether due wholly or partly or not at all to the given injury, the probable duration of the incapacity, the treatment which it has and will necessitate, and many other such questions form part of the medical testimony required in such cases. Sometimes with slight wounds the results, accompaniments, and complications may prolong the incapacity very greatly, as also the state of health and the habits of the wounded person, the neglect of treatment, improper treatment, etc.

Any bodily or mental infirmity or ill-health which may result from an injury and its necessary treatment in the past and future, all these questions and many more unnecessary to mention may be required of the medical witness. No general rules can be laid down for all such cases. In giving his testimony the medical man must depend in any particular case upon his knowledge, judgment, and experience.

We can seldom give a precise solution of the *question of survival* to determine the succession or inheritance if several of a family die together in an accident. In case of death from inanition, cold or heat, or in drowning especially, if some have wounds more or less grave in themselves, we can sometimes form an opinion. With wounds we cannot often do so, although in case of murder, the nature of the wounds, the position of the bodies, the examination of the spot of the accident or tragedy, may sometimes help us to form an opinion.

INCISED AND PUNCTURED WOUNDS AND WOUNDS OF BLUNT INSTRUMENTS REGIONALLY CONSIDERED.

The several varieties of wounds which we have been considering vary considerably in their nature, their effects, their danger, and in many other ways according to the region of the body in which they are situated. Some of these varieties are common in one situation and almost never occur in others. Although the nature of wounds found in the several regions of the body is not as important for a medical jurist as their danger and their influence in causing death, we will now consider the differences they exhibit on account of the region in which they occur.

WOUNDS OF THE HEAD.

These are often characterized by their apparent harmlessness and their real gravity sooner or later. We might almost make the opposite statement and say that those apparently grave are often virtually harmless, though this would be true only in a limited sense and in certain cases.

As to their *nature*, we find punctured wounds extremely rarely, incised and lacerated wounds frequently, while contusions and contused wounds are still more common. *Incised and lacerated wounds* of the head involve the scalp almost exclusively. These wounds heal remarkably well, even when the attachment is merely by a narrow pedicle, owing to the abundant blood-supply. Hemorrhage from the incised wounds is often free, for the vessels cannot retract, but it is seldom dangerous unless the wounds are very extensive. The only way in which they differ materially from similar wounds elsewhere is in the greater frequency of complicating erysipelas here than elsewhere. This is probably owing to the presence of septic conditions, as the head is generally dirtier than other parts of the body, and slight wounds especially are neglected and are not treated aseptically. If the scalp is shaved over a wide margin and cleaned like other parts of the body, erysipelas is found little or no oftener than with similar wounds elsewhere. The density of the scalp is so great that the redness and swelling accompanying inflammations are comparatively slight. If erysipelas follows slight wounds of the head, there is some reason to suspect constitutional predisposition or careless treatment, though as a matter of fact erysipelas may follow a slight wound quite as readily as a more severe one if it is not treated aseptically. From infection of such wounds of the scalp abscess or diffuse cellulitis of the scalp may develop as well as erysipelas, especially if the aponeurotic layer is divided and the "dangerous area" of the scalp is opened into. The constitutional symptoms in such a case may be marked or even severe, but the prognosis is favorable. In very rare cases necrosis of the skull may result or the inflammation may even extend to the brain. These incised and lacerated wounds of the scalp are usually accidental or inflicted by another; they are rarely self-inflicted. *Contusions and contused wounds* are the most common forms of injury to the head. These two kinds of injuries are almost invariably inflicted by another or are accidental. We have already seen that contused wounds of the scalp or over the eyebrow may closely resemble incised wounds in these localities. This fact should be borne in mind, as careful examination can usually distinguish them if they are fresh and until they begin to granulate. These wounds are liable to the same complications as incised wounds, in fact more liable, as the contusion makes the wound more susceptible to inflammation and the edges are more apt to be infected at the time of the injury.

One of the *results* of contusions of the head is the extravasation of blood, which may be subcutaneous, subaponeurotic, or subpericranial. These extravasations are usually in the form of a hematoma. Such hematomata when subcutaneous or subaponeurotic often present a hard circular or oval rim with a softer centre, and may readily be mistaken for fracture of the skull with depression. The diagnosis between hematoma and depressed fracture is not usually difficult, however, for with hematoma the ridge is elevated above the level of the skull and when subcutaneous is movable on the surface of the skull; also the wounded edges often pit on pressure. With depressed fracture, on the other hand, the edge is at or about the level of the rest of the skull; and it is sharper, more irregular, and less evenly circular than is the case with a hematoma. Contusions and the resulting hematoma may occasionally end by suppurating, but this event is rare. Contusions and contused wounds may occasionally show the marks of a weapon, indicating that they were inflicted by another. Also the position of the injury will indicate its origin, whether it is accidental or inflicted by another, for the former would not naturally occur on the vertex unless the fall was from a considerable height.

Another result of injuries to the head, especially of contusions and contused wounds, is FRACTURE OF THE SKULL. This may be simple or compound, depressed or not, etc. Fractures are serious inasmuch as they imply a degree of violence which may do damage to the brain. The fracture itself, especially if properly treated, affords a good prognosis, irrespective of any brain lesion. One variety of fracture of the skull offers an exception to this favorable prognosis, and that is fractures of the base of the skull. These may be fatal directly from injury of the vital centres at the base of the brain or soon fatal from hemorrhage in these parts. Or the fatal result may be secondary to an inflammation or meningitis which good treatment is often unable to prevent. It should not be considered that these fractures are uniformly fatal, for quite a considerable proportion recover. Fracture of the base usually occurs as the result of a fall. The injured person may land on the feet or buttocks, and yet receive a fracture of the base of the skull, the force of the fall being transmitted through the spine to the base of the skull. Fracture of the base of the skull usually occurs from an injury to the vault, not by *contre coup*, but as an extension of a fissure found higher up in the skull or as a "bursting fracture." The line of fracture is in line with or parallel to the force which produced the fracture, and in this way the base of the skull is fractured in different parts according to the point and direction of the application of the force. Thus in case the force compresses the skull antero-posteriorly the bursting fracture of the base will pass antero-posteriorly (see Fig. 13). Fractures of the vault of the skull occasionally occur opposite to the point struck; this may occur by *contre coup*, but not always so, as not infrequently in such rare cases a close examination may reveal an extension of a fissure from the point injured to the opposite pole of the skull. The shape and rarely the size of a fracture of the skull, especially if punctured in character, may show the shape and more rarely the size of the instrument or object which produced it. Apart from fracture of the base, the prognosis in fracture of the skull is serious, mainly on account of the concomitant brain lesion, the danger of inflammation, which is greater in compound fractures, and the more remote danger of irritation from depressed fragments causing epilepsy, insanity, etc., at a later period.

A circumstance that Taylor[1] says is connected with fracture of the skull with depression—namely, that the person, sensible as long as the object producing the fracture remained wedged in, became insensible and began to manifest other fatal symptoms as soon as it was removed—must be extremely rare. Its exceptional occurrence might be explained by the occurrence of hemorrhage after the object which occluded an open vessel by its presence or its pressure was removed. For it should be remembered that the symptoms of compression in a depressed fracture of the skull are very rarely due to the compressing

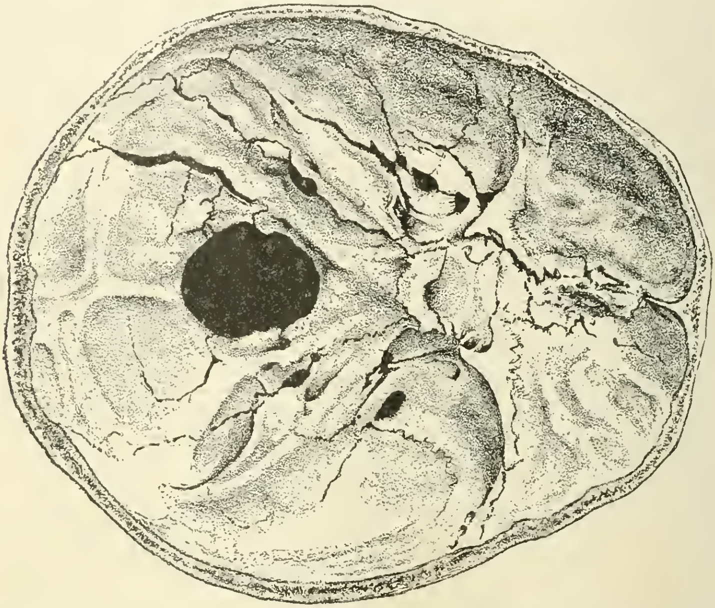


Fig. 13.—Several Fractures of the Left Half of the Base of the Skull, Running Parallel to One Another and Approaching One Another, also Separation of the Mastoid Suture. The injury was caused by a fall on the left side of the back of the head.

---

[1] "Med. Jurisprudence," 11th Amer. Ed., 1892, p. 334.

effect of the depressed bone, but rather to an injury of the brain, intracranial hemorrhage, or a local and often temporary interference with the circulation.

We may truly say that wounds of the head are dangerous in proportion as they affect the brain. The existence of affection of the brain may be hard to tell from the appearances, for an injured person may recover from the first effects of a comparatively slight wound and yet die suddenly later.

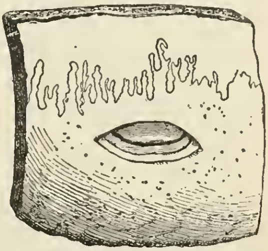


FIG. 14.—"Terraced" Fracture of the Left Parietal Bone near the Sagittal Suture, caused by the Lower Part of the Rim of a Round-Headed Hammer. The blow was struck from the right side. ½ natural size.

Concussion is the name applied to one of the effects on the brain of a more or less violent blow directly on the head or transmitted indirectly to the head. Though the term "concussion" implies a functional rather than an organic lesion, yet in the majority of cases it is equivalent to laceration of the brain. With laceration of the brain there is usually more or less effusion of blood which may be limited to a very thin layer. Concussion may exist without laceration of the brain. Even death has been known to occur from concussion of the brain without any visible signs of injury to the brain, so that the concussion must have been functional and the fatal result due to shock of the nervous system. Fatal concussion does not, therefore, necessitate the existence of compression laceration or any visible injury of the brain. Concussion may sometimes be due to a violent fall upon the feet, in which case the shock is transmitted

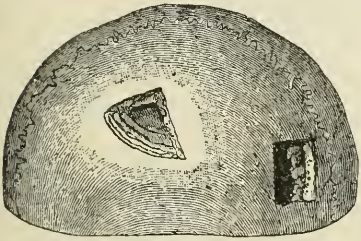


FIG. 15.—Fractures of the Skull caused by a Four-sided Hammer, One caused by the Corner, the Other by the End of the Head of the Hammer. ¼ natural size.

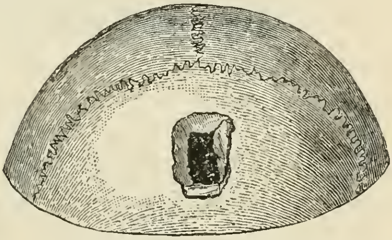


FIG. 16.—Four-sided Fracture caused by a Hatchet-Shaped Instrument, the Edges Formed by Depression of the Broken Outer Table of the Skull.

through the spinal column to the head with or without fracture of the base of the skull. It was in this way that the Duke of Orleans, the son of Louis Philippe, died.

The *symptoms of* concussion show all degrees of severity. Thus the injured person may become confused and giddy with or without falling, he may become pallid and nauseated and may vomit, but after a short period he recovers gradually.

With a more severe injury, with which there is generally some laceration of the brain, the injured person falls and lies quiet and relaxed, apparently unconscious, though often he can be partly roused. Paralysis and anæsthesia are absent. The heart is feeble and fluttering, the skin cold and clammy. The pupils, as a rule, react to light, but otherwise vary considerably. Urine and fæces may be passed involuntarily. As he begins to regain consciousness, vomiting usually occurs. Consciousness usually returns within twenty-four or forty-eight hours, when headache and indisposition to exertion are complained of, and this may last for a long time. Occasionally the symptoms instead of abating increase, and coma supervenes, often indicating meningitis, encephalitis, or intracranial hemorrhage. In other cases the person may die almost immediately on the spot where he fell, while in still others apparent recovery takes place and death occurs at a later period either suddenly or after

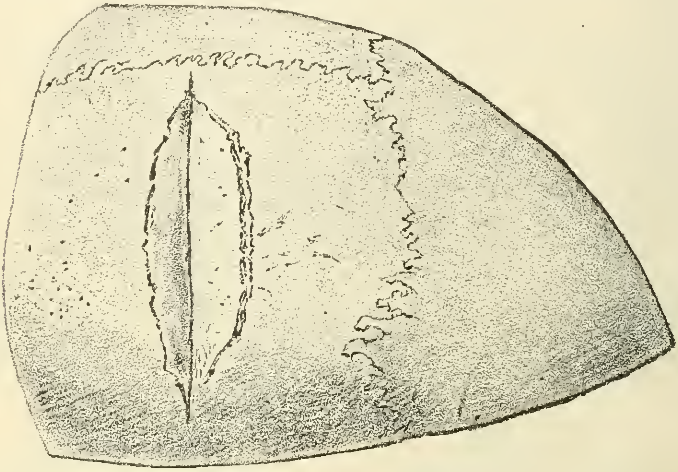


FIG. 17.—Fracture of Parietal Bone with Depression, caused by the Blow of an Axe.

a reappearance of symptoms. In such cases, *abscess of the brain* may occur and be the cause of the fatal result. These abscesses are the result of the injury, which may be almost anything from a compound fracture to a slight contusion not leaving any scar. The abscess may occur within a week[1] or not until after months or years. This interval of apparent recovery may lead to the false supposition that death was not due to the injury, but to some intervening cause. It is well to bear in mind that over half of the cases of abscess of the brain are not traumatic. A large majority of these are due to suppuration in the middle ear, a few to septic diseases or tuberculosis. The situation of the abscess often distinguishes between the traumatic and non-traumatic varieties. The traumatic variety is usually found beneath the injury or sometimes directly opposite, where the brain is injured by a kind of focussing of the radiated effects of the blow. The cases of abscess of the brain due to ear disease are usually found in the temporal lobe of the brain lying over the position of the ear, or in the cerebellum behind it. The uncertainty of the nature and the extent of the cerebral injury

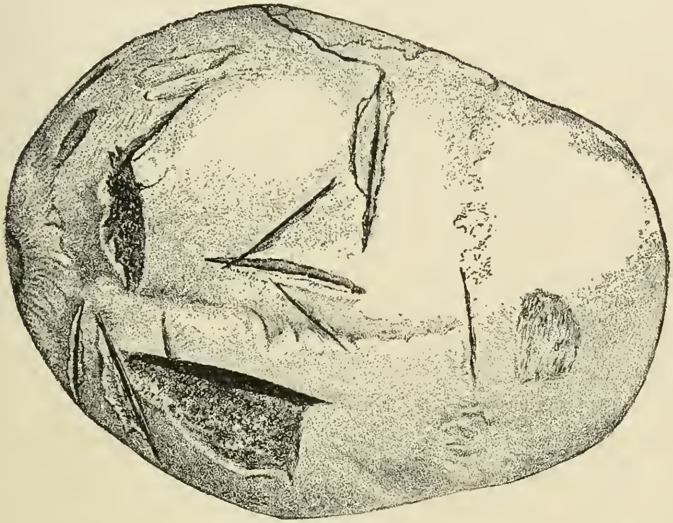


FIG. 18.—Wounds of the Vault of the Cranium caused by Artillery Side-Arms, followed by Death shortly after.

---

[1] London Lancet, 1873, i., p. 697.

in so-called contusion of the brain renders it necessary to be very careful in giving a *prognosis*. Any injury should be considered serious which has produced unconsciousness, for such an injury may produce enough laceration of the brain to render serious danger possible or even probable. We have seen that as a rule the symptoms of concussion come on immediately, but it is possible that symptoms at first so slight as to escape notice may become serious in a few hours or days. A gradual hemorrhage may sometimes account for this.

It is of medico-legal interest that as a rule the patient has lost more or less completely and forever all recollection of occurrences at the time of the injury and just before it. The knowledge of certain acts performed or a conversation held at the last moment before the injury may be retained after recovery from concussion of the brain. This is not necessarily the case, for instead of remembering up to the moment of the injury, the injured person may remember only up to a certain time shortly before, or a part and not everything may be remembered.

The *diagnosis* of concussion of the brain *from alcoholism* is sometimes a matter of medico-legal interest or importance. Concussion may be so slight as to simulate intoxication. The history often clears the case up. The history of a blow or a fall or the presence of marks of violence on the head indicates concussion, though the blow or fall may not have caused the symptoms, which may be due to alcoholism. The odor of the breath may indicate alcoholism, but here too we may have both present and the concussion may be responsible for the symptoms. Or again the alcohol may have been given as a heart stimulant after the accident. This combination often occurs. If there is no odor in the breath, the presumption is in favor of concussion. As mistakes are still not infrequently made in diagnosis, those cases in which there is any ground for doubt should be carefully watched for developments. In general, the existence of concussion is more often overlooked than the coexisting alcoholism, so that if there is any doubt in a given case it should be treated as one of cerebral injury. The injury which causes the concussion in such cases is often due to the alcoholism. We may be able to verify this supposition if the injury is such as would be likely to be caused by a fall. There may be nothing found in the brain after death to distinguish between concussion and alcoholism. A bruise on the head only indicates a probability of concussion, for the bruise and alcoholism may both be present, the former perhaps due to the latter. The presence of alcohol in the stomach would indicate the existence of alcoholism.

Another effect of an injury which has caused concussion of the brain is an *extravasation* or *effusion of blood.* Extravasation of blood in or on the brain is one of the commonest causes of death from injury to the head. It may occur with or without marks of external injury. A person suffering from such an extravasation of blood may recover from the first effects of the injury, and at a varying time afterward the symptoms may return and increase so as to result fatally. In such a case the opening of the bleeding vessel may have become plugged until some exertion, emotion, or excitement on the part of the injured person has loosened the plug. A hemorrhage may have ceased from partial syncope and return with a stronger heart action due perhaps to the administration of alcohol. As a rule, however, the delay in the appearance of the symptoms due to the extravasation is caused by the fact that it requires some time for the extravasation to attain such a size as to produce symptoms. This is especially the case when the extravasation is due to a rupture of the middle meningeal artery. This effusion may occur on the surface of the brain in connection with a superficial laceration of the brain or just beneath or outside the dura mater and not involving the brain directly. The latter cases are almost always due to the effects of violence, though there is at least one case of apparently spontaneous rupture of the middle meningeal artery. The violence which causes a rupture of the branches of this artery may be so slight as to leave no bruise or so severe as to cause fracture of the skull. The most important symptom of such extradural hemorrhage is a period of consciousness after recovery from the first effects of the injury, then stupor may appear and deepen into coma. A subdural hemorrhage may cause almost the same symptoms, though the injury is usually such as has produced a depressed fracture. This hemorrhage is most often due to the rupture of a number of small vessels under the fracture, though if one larger vessel is ruptured it is most often the middle cerebral. A thin layer of hemorrhage in connection with a superficial laceration of the brain is of frequent occurrence with or without the other two forms of intracranial hemorrhage. If the brain is lacerated we may have convulsions in addition to other symptoms. Death occurring during or soon after a prize-fight may result from some of the above classes of intracranial extravasations. It may be questioned whether the blows or a fall caused the hemorrhage. It is generally due to a fall in such cases, though it may be due to blows, but the guilt is the same unless the fall was accidental. As the result of severe traumatism the vessels of the interior of the cerebrum may be ruptured or hemorrhage may occur into the ventricles of the brain. In such cases the symptoms will resemble those of ordinary apoplexy, only the cause is different from the latter and the injury is usually so severe as to leave no doubt as to the existence of a traumatism. The following question may arise in cases of intracranial hemorrhage and especially in the latter class of such cases, *i.e.*, in cerebral hemorrhage:

WAS THE EXTRAVASATION OF BLOOD DUE TO DISEASE OR VIOLENCE?—It may be alleged in defence that the hemorrhage was the natural result of disease. Where the hemorrhage is extradural or subdural or in connection with a superficial laceration of the brain, the cause is almost always traumatic. We have referred to one case of extradural hemorrhage from spontaneous rupture of the middle meningeal artery.[1] Subdural hemorrhage may occur from *Pachymeningitis hæmorrhagica interna*, but this condition is readily diagnosed on post-mortem examination and often with considerable certainty during life. A history of alcoholism, headache, impaired intellect, unsteady gait, occasional losses of consciousness, stupor increasing to coma, etc., indicates such a condition.

It is in cases of cerebral hemorrhage that there is the most difficulty in discriminating between that due to disease and that due to injury. It may be alleged that the hemorrhage was from diseased vessels, or that the effects of a blow, which cannot be denied, were aggravated by disease of the cerebral vessels or by excitement due to intoxication or passion. Cerebral hemorrhage from disease is rare before 40 years of age, except in alcoholics. When the hemorrhage is due to disease the blood-vessels are diseased. The most frequent site of such hemorrhages is in the area supplied by the lenticulo-striate artery in the ganglia of the base or the white substance of the centrum ovale.

When injury is the cause of the hemorrhage it is usually found beneath the point injured or directly opposite to this. External signs of the blow are generally visible if it be severe enough to cause a cerebral hemorrhage. The vessels may be perfectly healthy and the victim quite young if the hemorrhage is due to an injury, also the ruptured vessels may be plainly torn. The most difficult cases are those where there is the history of an injury and at the same time such a condition of disease of the cerebral vessels, etc., as would account for spontaneous hemorrhage. Where the injury was slight in the case of alcoholics or aged people the medical witness should be especially cautious in stating that a cerebral hemorrhage was due to the injury. Then, too, in the act of falling from the occurrence of a cerebral hemorrhage due to disease the head may be injured and show marks of violence. It should also be borne in mind that an injury to the head may be inflicted when disease of the brain, vessels, or membranes already exists. In such a case a slight blow might cause extensive hemorrhage, but as that which accelerates causes, death, even though it might sooner or later have occurred in the same manner without injury, is due to the injury inflicted.

---

[1] "An American Text-Book of Surgery," 1892, p. 496.

From the above considerations we see that spontaneous cerebral hemorrhage or that due to disease are not always easily distinguished from that due to violence. In severe injuries the structure of the brain is plainly bruised, etc., but the greatest difficulty exists in cases of slight violence where arteritis of the cerebral blood-vessels coexists. The spontaneous extravasation of blood in or upon the brain from excitement does not usually occur except with diseased vessels, old age, or alcoholism. It is rare, therefore, in the young and healthy. If there is any doubt as to the origin of the hemorrhage, the medical witness should state the cause most probable in his judgment. Taylor[1] supposes the case of a man excited by passion, alcohol, or both, who becomes insensible and dies after being struck a blow so slight that it would not have affected a healthy person. If examination reveals a quantity of blood effused into the substance of the brain, there can be little doubt in the mind of the medical man that the excitement was the principal cause of the effusion. On the other hand, if a severe blow or a violent fall on the head had been received in a personal conflict with another and it is found that death was due to an effusion of blood upon the surface, there can be little doubt in the mind of the medical examiner that death was due to the blow, which would satisfactorily account for the conditions found without reference to coexisting excitement, etc. In fact, in all cases where a question is raised as to the cause of the hemorrhage, it is most important to consider whether the violence was not sufficient to account for the hemorrhage without the coexistence of disease or excitement. It is also most important to bear in mind that after severe injuries, as after a fall, causing extensive fracture of the skull, followed or not with extravasation of blood, the injured person may walk about and die some distance from the place of the accident and where no chance for a similar accident exists. In this way the suspicion of murder may be occasioned, as illustrated in the following case cited by Taylor:[1] A man was accused of the murder of his companion, who was found dead in a stable with fracture of the temporal bone which had caused rupture of the middle meningeal artery. The accused stated that the deceased had been injured by falling from his horse the day before. After the fall, however, the deceased had gone into a public-house, where he remained some time drinking before returning to the stable. The extravasation had here taken place gradually, as is characteristic of hemorrhage from the middle meningeal artery, and perhaps the excitement due to the drinking had influenced it.

---

[1] "Med. Jurisprudence," 11th Amer. Ed., 1892.

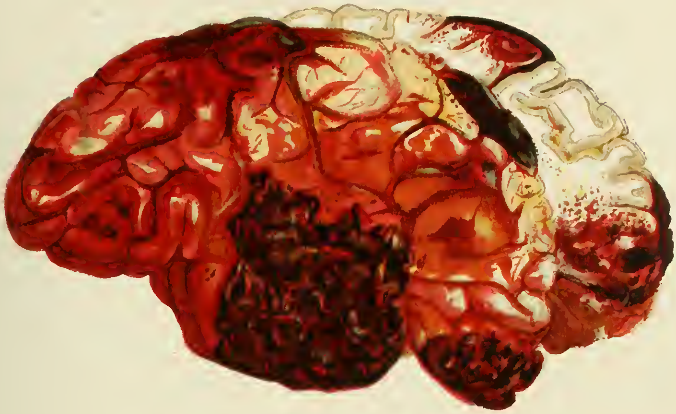
THE DATE OF AN EFFUSION OF BLOOD may sometimes be a matter of importance in determining whether a given extravasation of blood in or on the brain was caused by a recent blow or had existed previously. The color and consistence of these effusions indicate whether they are old or recent; the precise date we cannot state, but the information we can give is often all that is required. The color of recent effusions is red, which changes after some days to a chocolate or brown, which generally turns to an ochre color (see Plate II.). This latter color may be met with from twelve to twenty-five days after the injury. The consistence of the coagula also becomes firmer with age, and as the coagula become firmer they are more or less laminated and the expressed lymph may lie between the laminæ or around the coagula.

On account of the many layers of the brain coverings, a

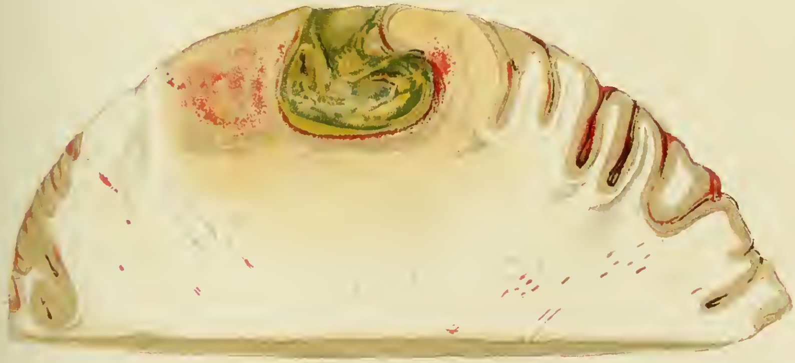
---

[1] "Med. Jurisprudence," 11th Amer. Ed., 1892.

MEDICAL JURISPRUDENCE—PLATE II



XTRAVASATIONS IN SEVERAL PORTIONS OF THE ARACHNOID, WITH HEMORRHAGES IN NEIGHBORING PORTIONS OF THE BRAIN. DEATH IN FOUR DAYS.



CEREBRAL ABSCESS. EPILEPSY, PARESIS. DEATH 3¼ YEARS AFTER THE INJURY.

RECENT AND OLD CEREBRAL EFFUSIONS.

rough diagram of the coverings as given by Taylor[1] may be of much use to the medical expert in illustrating his evidence so as to make it clear to the court (see Fig. 19).

Wounds of the brain vary very widely in their immediate results according to the part of the brain injured. Thus sometimes a slight wound of the brain may be instantly fatal and often a severe wound in another part is not so. Extensive wounds may occur especially in the frontal lobes with remarkably slight disturbance. If a person with a wound of the brain survives the first effects of the injury the danger of inflammation remains. This danger may not be removed for a long time, for the inflammation may develop very slowly, not showing itself for from three to ten weeks or even later. Thus Taylor[1] cites the case of a child who was accidentally shot through the brain. The symptoms of inflammation did not appear until the twenty-sixth day and death occurred on the twenty-ninth day.

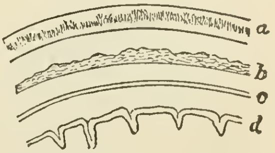


FIG. 19.—Diagramatic Representation of the Skull and Membranes of the Brain for Exhibition in Court. *a*, Skull with outer and inner tables and diploë; *b*, dura mater; *c*, arachnoid membrane; *d*, pia mater.

Wounds of the face heal remarkably well on account of its great vascularity. If severe they may leave great deformity or disfigurement, which may be the ground of a civil suit and thus require the testimony of a medical expert. If the wound involves the orbit or its contents it may be more serious, either from a fracture of the thin upper or inner wall of the orbit, which separates it from the brain, or from extension of a secondary inflammation of the contents of the orbit to the brain. Wounds of the eyebrow may cause supraorbital neuralgia or amaurosis from paralysis of the upper lid. Some fractures of the nose, especially those due to severe injury near the root of the nose, may be more serious than they appear. For in such cases, of which the writer has seen several, the fracture is not confined to the nose, but involves also the ethmoid bone and its cribriform plate forming part of the base of the skull. The injury is in fact a fracture of the base of the skull. In such a case a fatal meningitis is a common result.

Wounds of the neck are very rarely accidental, more often homicidal, but most often suicidal. In nature they are most often incised wounds. As we have already seen, the kind and condition of the weapon used is often indicated by the character of the wound. We have also seen that in many cases a suicidal wound of the neck can be distinguished from a homicidal one with more or less probability or even certainty. Wounds of the neck are often dangerous, and they may be rapidly fatal if they divide the main vessels, especially the carotid arteries. Wounds of the larynx, trachea, and œsophagus are grave and often fatal from entrance of blood into the air-passages or from subsequent œdema or inflammation occluding the air-passages. Wounds of the sympathetic and pneumogastric nerves may be fatal, and those of the recurrent laryngeal nerves cause aphonia. The situation of the average suicidal or homicidal cut-throat wound is in front, generally across the thyro-hyoid membrane, sometimes dividing the cricoid-thyroid membrane, and not at the side of the neck where the great vessels lie and would be more easily divided. The force is expended, as a rule, before the great vessels are reached. The epiglottis may be cut or detached and the incision may even reach the posterior wall of the pharynx, but the majority of the suicidal cases recover with proper treatment. The homicidal cases are more often fatal from division of the great vessels, though, as-already stated, in either class of cases a fatal result may occur, if the air-passages are opened, from the entrance of blood into them and the consequent asphyxia.

---

[1] "Med. Jurisprudence," 11th Amer. Ed., 1892.

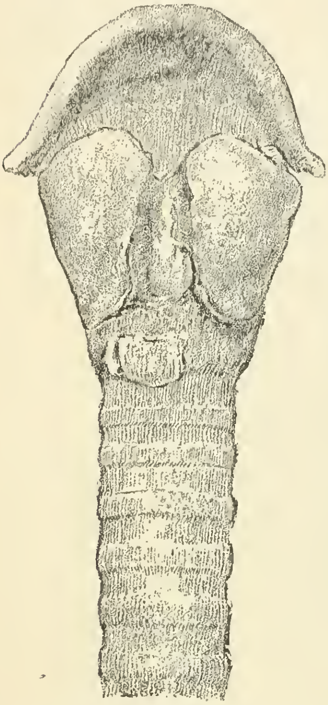


Fig. 20.—Double Fracture of the Thyroid and Cricoid Cartilages of the Larynx, from the Blow of a Flat-Iron.

Contusions of the neck may be so severe as to cause unconsciousness or even death. The latter may be due to a reflex inhibitory action, as in cases of death from a blow upon the pit of the stomach. As a result of contusions of the neck we may have a fracture of the larynx, usually confined to the thyroid and cricoid cartilages (see Fig. 20). This may be followed by hemorrhage from the larynx, some of which may pass down into the trachea and threaten death from asphyxia. Later emphysema often develops throughout the tissues of the neck, and there is great danger of œdema of the larynx. The prognosis is serious unless tracheotomy is performed early or the case is closely watched. It is most serious where the cricoid cartilage had been fractured, as this requires a greater degree of violence. Whereas incised wounds of the throat are most often suicidal, contusions are most often accidental or inflicted by another. Among the latter class of injuries may be included the so-called *garroting*, by which a person is seized violently around the throat, usually from behind, and generally with a view to strangle and rob. In such cases the larynx or trachea may be injured in the same way as by a contusing blow.

WOUNDS AND INJURIES OF THE SPINE AND SPINAL CORD.

Injuries of the spine resemble more or less closely those of the head. FRACTURES OF THE SPINE generally occur in combination with dislocation, as fracture-dislocation. Displacement is generally present and may cause a fatal compression or crushing of the cord. When the cord has once been crushed at the site of the displacement of the fracture-dislocation there is practically no hope of its ever healing. Therefore the lower end of the cord is never again in functional connection with the brain. These injuries are more rapidly fatal the higher up they are. If the injury is above the fourth cervical vertebra death is nearly immediate, for then even diaphragmatic breathing is impossible, and the injured person dies of asphyxia. Fracture of the odontoid process of the axis or of the transverse ligament which holds it in place, which sometimes occurs in hanging, may also occur from falls on the head, etc., and is not always immediately fatal. Thus in one case[1] the person lived fifteen months and in another case sixteen months. In the latter case the fracture was due to the patient turning in bed while his head was pressed on the pillow. In some cases it may be questioned how far this injury may result from disease of the bones or ligaments. Therefore a careful examination of these parts should be made after death, which will usually enable us to answer this question, which may be brought up by the defence. It is hardly necessary for our purpose to enumerate the symptoms of fracture-dislocation of the spine. Of course the patients are almost always unable to walk and so are bed-ridden. A marked feature of fracture-dislocation of the spine is the length of time intervening between the injury and the fatal termination, and yet the injury is wholly responsible for the death of the injured person. This delay may last for months or even for years with careful treatment. But sooner or later the case generally ends fatally, though not necessarily so. Where the cord has been entirely crushed the result is almost always fatal; where the cord is not so injured recovery may and often does occur. According to Lutaud,[1] fractures of the spine are sometimes followed by secondary paralysis coming on after healing of the fracture. At the outset we can seldom give a definite *prognosis*, which can only be given after watching the developments of the case. The prognosis is more favorable in fracture of the arches alone or when the injury is in the lower part of the spine and not very severe. The commonest cause of fracture-dislocation of the spine is forced flexion of the spinal column. Injuries to the spine are generally the result of falls or blows on the spine, especially in its lower part. Lutaud[1] states that after forced flexion of the spine without fracture paraplegia may sometimes occur, which is attributed to forced elongation of the cord. This paraplegia, which may seem to be grave, is completely recovered from as a rule.

---

[1] Edin. Med. and Surg. Jour., Oct., 1845, p. 527.

Incised or punctured wounds of the spinal cord are rare, as it is so well protected except in the very highest part behind. Here between the occiput and the atlas and between the latter and the axis, and to a less extent between the axis and the third cervical vertebra, the cord is more exposed, owing to the narrowness of the laminæ. It is here that *pithing* is done, which is almost instantly fatal, as the medulla and upper part of the spinal cord are the parts injured, and they contain the respiratory and other vital centres. Pithing may be done with such a small needle-like instrument as to leave scarcely any trace. Only a slightly bloody streak may persist, which may appear superficial if the instrument is introduced obliquely. Such a mark in this location with no other apparent cause of death should always lead to an examination of the upper part of the cord, which will always reveal the cause of death in such cases. Pithing is practised especially in infanticide.

---

[1] "Manuel de Méd. Lég.," 5th Ed., 1892.

As with the brain, so with the spinal cord, we may have a train of complicated symptoms attributed to CONCUSSION and due to the shock of a contusing blow. Concussion of the spinal cord, as of the brain, may be fatal and yet show scarcely a mark of violence externally or internally. As the cord is so well protected from injury, it must be extremely rare to have concussion of the cord without some actual lesion of its substance. As concussion of the cord is not often the result of the injuries of which we are treating, but rather of railroad injuries and the like, it will not be considered at length in this connection. As a result of a blow or fall on the spine or communicated to it, hemorrhage may occur in the substance of the cord or around it between or outside its membranes. In very rare cases such a hemorrhage may occur spontaneously as the result of disease, of which the writer has seen one case. It may be associated with concussion or laceration of the cord. It may destroy life directly by extension or indirectly by leading to a spreading inflammation. Hemorrhage in or about the cord causes a gradual compression of the cord, and in cases of fracture of the spine often adds to the compression due to the displacement of the bones. In hemorrhage into the substance of the cord paralysis comes on early or immediately and may be complete while symptoms of irritation fail. The latter symptoms are most marked in meningeal hemorrhage in which paralysis is delayed in appearance and generally incomplete. The products of an inflammation due to an injury or a disease of the spine may compress the spinal cord in the same way that hemorrhage does.

Wounds and injuries of the varieties we are considering, affecting the spine and spinal cord, are generally accidental, less often homicidal, and almost never suicidal.

WOUNDS OF THE THORAX AND THORACIC ORGANS.

Wounds of the thorax caused by incising, puncturing, or blunt instruments. These wounds are most often punctured wounds; contused wounds are common and incised wounds are not rare. They are perhaps most often homicidal in origin or at least inflicted by another, and the accidental origin of these wounds is probably the least common.

Incised or punctured non-penetrating wounds of the thoracic wall are rarely grave. Bleeding, as a rule, is not serious, though it may be quite free. Such wounds may be accompanied by emphysema, though not penetrating, owing to the movements of the chest and a valve-like action of the edges of the wound. Contused wounds of the thorax are more dangerous, especially if due to great violence, owing to the complicating fracture of the ribs, rupture of the thoracic viscera, etc.

FRACTURE OF THE RIBS is a common result of contusions of the chest. It is more dangerous when due to a direct blow or injury, as then the splintering occurs internally and may wound the lungs, heart, or large vessels, while with fracture from indirect violence, from compression of the chest, the splintering of the ribs occurs externally. Fracture of the upper ribs requires more force than that required to fracture the lower ones, and consequently the former is the more dangerous owing to the danger of the complicating visceral lesions. The diagnosis of fracture of the ribs is generally quite easy by means of crepitus felt or heard, false motion, local tenderness, etc. FRACTURE OF THE STERNUM may be serious if depressed on account of the wounding of the viscera behind it. Devergie[1] cites such a case where the depressed portion of the sternum produced a transverse non-penetrating wound of the heart about an inch in length, which had caused death in thirteen days. Simple fracture of the sternum without displacement of the fragments is rarely serious unless injury of the thoracic viscera is produced by the same violence. Wounds or injuries of the thorax are grave or not according as they penetrate or injure the thoracic viscera or do not do so. A wound may just penetrate the thoracic wall without wounding the thoracic viscera, and is then serious as a rule only when followed by inflammation. In fact, many of the penetrating wounds of the thorax wounding the viscera are only grave on account of consecutive inflammation. We have already seen that various characteristics of wounds of the thorax, especially of stab-wounds, enable us to determine the kind of weapon used, its size, sharpness, etc., and sometimes to identify the weapon itself. In much the same way we can often determine whether the wound was suicidally or homicidally inflicted. The cause of death in wounds of the thorax may be directly due to the wounding of one or more of the thoracic viscera, or it may be due to the inflammation occasioned by it. Wounds of the lower part of the thorax may involve at the same time the thoracic cavity proper and its contained viscera, the diaphragm and the abdomen and its viscera. This is the order in which the different parts would most likely be met with in a wound. Penetrating wounds of the thorax may involve the lungs, heart, or great blood-vessels. Of these, the lungs are most often injured, which is easily accounted for by the greater size of the lungs. In **wounds of the lungs** the immediate danger is from hemorrhage. The hemorrhage appears externally through the wound and from the mouth, being coughed up. Where the lungs are injured by a blow, fall, or crush without exernal injury, blood appears in the mouth only. The blood coughed up from the lungs is bright red and frothy, and it may also be frothy at the external wound. Hemorrhage from the external wound may be slight, especially if the wound is oblique and acts as a valve. In wounds of the lungs most of the blood may collect in the pleura or in the lungs, and thus, by compression from without or by displacement within the lungs, prevent air from entering the lungs and produce asphyxia, which may be fatal. More or less dyspnœa usually occurs at first. Emphysema is generally present in the cellular tissues, but this latter symptom may also occur at times with non-penetrating wounds of the chest. If death does not occur speedily from hemorrhage by compression of the lungs or heart, there are good hopes of saving the patient, but the prognosis should be reserved. For even when the first effects of the wound of the lung are survived, the patient may die from the effects of inflammation, recurring hemorrhage, or a too sudden relaxation of regimen. Thus, for instance, if too much food, talking, or exertion are indulged in the case may on this account terminate fatally, and such aggravating causes of death may mitigate the sentence.

---

[1] "Méd. Lég.," t. 2, p. 243.

Wounds of the heart are among the most fatal. Although it was once considered, and is now usually thought by laymen, that penetrating wounds of the heart must be necessarily and instantly fatal, the facts are otherwise. If the wound is small and oblique or valve-like life may be prolonged, and cases are recorded[1] in which wounds of the heart were not directly fatal, and others in which recovery would have probably resulted if not for other diseases. As already stated Ninni in 1898[2] found by combining the statistics of Jamain, Latelenet, and Fischer that immediate death occurred in only 19 per cent of penetrating wounds of the heart. Also in a series of twenty-nine cases of penetrating wounds mentioned by Devergie,[3] as collected by Ollivier and Sanson, only two ended fatally within forty-eight hours, the rest in periods ranging from four to twenty-eight days. Cases in which the heart wall was wounded but not penetrated, and in which healing took place, are not very rare.[4] Thus Callender removed a needle from the substance of the heart. One case[5] was recorded in 1844 in which a wound penetrating the cavities of the heart was recovered from, and there have been others since then. It is therefore the rule rather than the exception that wounds of the heart, penetrating or not, are not immediately fatal. This delay in the fatal result has been attributed to the arrangement of the muscle fibres crossing one another and tending to close the wound, or at least to make it smaller. As to the various parts of the heart wounded, the right side, especially the ventricle, is most often wounded. Thus out of fifty-four cases of wounds of the heart, Taylor[6] states that the right ventricle was wounded in twenty-nine cases, both ventricles in nine, the right auricle in three, and the left auricle in one case. This greater frequency of wounds of the right side of the heart is easily accounted for by its more exposed position anteriorly, just beneath the chest wall in a part of its extent. The rapidity of death depends largely upon the site and extent of the wound. Lutaud[7] states that out of twenty-four cases of wounds of the right ventricle only two were fatal within forty-eight hours, and out of twelve cases of wounds of the left ventricle three were not immediately fatal. Wounds of the auricles are generally fatal immediately, especially if the cavity is extensively laid open. It is the general opinion that wounds of the auricles are most rapidly fatal, next those of the right ventricle, and lastly those of the left ventricle. This difference is probably due to the comparative thickness of the walls of these parts. Thus the wall of the left ventricle is so thick as to tend to close a wound unless it be extensive. In wounds of the heart death rarely occurs from external hemorrhage, which may be quite slight or even altogether wanting where the wound is due to a crush or fracture of the ribs. Death is usually due to the compression of the heart by the blood in the pericardium. This usually causes syncope, or a slighter pressure may be fatal by causing cerebral or pulmonary anæmia or shock. Death may occur suddenly in this manner or not until after some time. Thus in penetrating stab-wounds little or no blood probably escapes at first, in most cases, but it may ooze or, later on, suddenly burst out into the pericardium. Therefore, as stated above, after a wound of the heart the patient does not, as a rule, die immediately, as formerly and often at the present time erroneously supposed. This fact is of importance in the surgical treatment, for it allows time in 80 per cent of cases for operative treatment by suture of the wounds which gives the best results, and hence is imperatively indicated. Thus Ninni, in the article cited above, collected in 1898 8 cases of suture of penetrating wounds of the heart with recovery in 3 cases (37.5 per cent). The fact that death does not as a rule occur immediately after penetrating wounds of the heart is also of importance in medical jurisprudence, for upon it may hang the solution of questions of murder, suicide, or justifiable homicide. It also accounts for the fact that the injured person can exercise voluntary power after the injury. Thus Watson[1] met with a case where a man ran eighteen yards and died six hours after a stab-wound of the right ventricle. The coronary artery was divided and the pericardium was filled with blood. Also Boileau met with an accidental penetrating stab-wound through both ventricles in a soldier who ran two hundred yards, then fell and died in five minutes. A boy admitted to Guy's Hospital in 1879 lived forty-two hours with a bayonet-wound transfixing the right auricle, the septum, the left ventricle, the mitral valve, and entering the left auricle.

---

[1] Beck, vol. ii., pp. 329, 333; Wharton and Stillé, 2d Ed., p. 580; N. A. Med. and Chir. Review, March, 1859, p. 299; N. Y. Med. Times, Apr. and May, 1855; Amer. Jour. Med. Sciences, July, 1861, p. 292, and Aug., 1829, p. 307.

[2] Giornale internazionale delle scienze mediche, Jan. 15th, 1899.

[3] "Méd. Lég.," t. 2, p. 253.

[4] Amer. Jour. Med. Sci., July, 1861, p. 292. Case of bullet in heart wall for twenty years.

[5] Edin. Med. and Surg. Jour., Oct., 1844, p. 557.

[6] "Med. Jurisprudence," 11th Amer. Ed., 1892.

[7] "Manuel Méd. Lég.," 5th Ed., 1892.

---

[1] Quoted by Taylor, "Med. Jurisprud.," 11th Amer. Ed., 1892, p. 340.

Minute wounds of the chest are sometimes made by needles, etc., in the region of the heart with the intention of killing infants or children. Taylor[1] also mentions the case of a fatal wound of the heart from a needle, the result of accident. We have already cited the case of a needle lodged in the heart wall and removed by Callender by operation. That the puncture of the heart by a small instrument is not necessarily serious is proved by the experiments of Senn,[1] by which he found that "the heart can be punctured with a perfectly aseptic, medium-sized aspirator needle without any great immediate or remote danger."

In cases of RUPTURE OF THE HEART the question may come up as to whether it was the result of disease or violence. We have already seen that rupture of the heart may occur from falls or crushes without marks of violence to the chest. In general, we may say that in rupture of the heart from violence the right side and base are most often involved, while in rupture from disease the left ventricle is generally ruptured, especially near the apex. The exciting causes of rupture of a diseased heart are often violent emotions or exertion, which may both be present in a quarrel with another and cause rupture without direct violence. The cause need be but slight if the heart is diseased, whether the cause is a natural one or outward violence. Rupture from disease may therefore excite suspicions of murder, but those cases can usually be satisfactorily solved by examination of the organ post mortem. A slight degree of violence may cause rupture of a diseased heart about ready for rupture from natural causes. When a diseased heart ruptures during a quarrel, the symptoms of rupture of the heart may be observed to come on suddenly before and without the infliction of any violence.

Wounds of Arteries and Veins, especially within the thorax.—Wounds of large trunks are generally speedily mortal. In the chest we may occasionally meet with wounds of the intercostal or internal mammary vessels or the vena azygos veins. These wounds are often serious and may be fatal. We have already seen that blood in the large cavities of the body, like the chest, is commonly not coagulated, or at least the greater part of it. We have already seen, too, that after wounds of the carotid artery the victim may preserve the power of locomotion for a short time, but not the power of struggling. This fact may be important to help distinguish between murder and suicide. In such wounds of the carotid the voice may be lost, as the trachea is often divided. Death from wounds of large vessels may be due to loss of blood, and if this danger is passed the case may still terminate fatally, as in a case where the brachial was tied for injury, and death occurred in three days from gangrene. The wounds of comparatively small vessels may prove fatal from hemorrhage, etc.

---

[1] "Med. Jurisprudence," 11th Amer. Ed., 1892, p. 351.

[2] Senn: "Experimental Surgery," 1889.

In wounds of blood-vessels death may occur from the *entrance of air* into the large veins. In some cases where this is supposed to have occurred it is quite probable that death was really due to hemorrhage. A certain quantity of air may enter the veins and pass to the heart without a fatal result. When death does occur it is owing (1) to "mechanical over-distention of the right ventricle of the heart and paralysis in the diastole," or (2) to "asphyxia from obstruction to the pulmonary circulation consequent upon embolism of the pulmonary artery."[1] Senn found that fatal air embolism could hardly occur spontaneously in a healthy jugular vein, as the walls collapse readily from atmospheric pressure.

Wounds and Ruptures of the Diaphragm.—These may be due to weapons, fracture of the ribs, falls or crushes, and may be facilitated by disease or congenital weakness. They also occur as the result of congenital malformation, though these cases seldom survive long. These injuries are generally homicidal or accidental in origin. As a rule, the viscera are wounded at the same time or, if not wounded, at least herniated, and may become strangulated. It is therefore hard to estimate the danger in such cases, but the prognosis is at all times serious. The most serious cases of such injury to the diaphragm are due to violent contusions or falls when the stomach and intestines are full. The hemorrhage is usually slight, but hernia of one or more of the abdominal viscera usually occurs in such cases, and is said to be more readily produced during inspiration when the fibres are on the stretch. According to Devergie, rupture of the diaphragm with hernia is more common on the left side in the central tendon in front of the crura and at the junction of the left muscular leaflet. Also on either side of the ensiform cartilage and especially on the left side there occurs an area of the diaphragm which may be congenitally weak or even absent, and here too rupture and hernia are likely to occur. *Phrenic* or *diaphragmatic hernia* occurs especially after lacerated wounds, even after the wounds have apparently healed. If hernia occurs long after the injury was inflicted, it may be asked whether the wound was the cause of the hernia, and so of death. This can only be determined by examination. Almost any or all of the movable abdominal viscera may be found in a diaphragmatic hernia. It was once supposed that this accident would be immediately fatal, but this is far from the truth. Devergie relates the case where a person lived nine months with the stomach and colon in the chest and died from another cause. Thus a person may have a phrenic hernia and die from another cause, or having had a rupture or wound of the diaphragm he may suddenly acquire a diaphragmatic hernia by reason of a blow or sudden exertion, or the latter may strangulate an existing hernia. A person with a diaphragmatic hernia may have the power of moving or walking, but is more or less incapacitated owing to the compression of the lungs which exists and the consequent dyspnœa, etc.

---

[1] Senn: "Experimental Surgery," 1889.

WOUNDS AND CONTUSED INJURIES OF THE ABDOMINAL WALL AND VISCERA.

Such wounds and injuries of the abdominal wall may be incised, punctured, or due to blunt instruments, etc. They are usually homicidal or accidental, seldom suicidal except in delirious patients or lunatics. Death in such cases may be due to hemorrhage, shock, etc., or to secondary inflammation, which is especially likely to occur in penetrating wounds. The kind of weapon used may often be judged from the nature of the wound. Incised and non-penetrating punctured wounds are usually simple and not grave, but may be otherwise from hemorrhage from the deep epigastric artery, or from inflammation in or between the muscles, or in the subperitoneal connective tissue. In the latter case peritonitis may occur, but is rare. A ventral hernia may, however, result later on, as also from many cicatrices. In such cases the question arises whether the natural results of the wound were aggravated by unskilful or improper treatment or even wilful neglect on the part of the patient or the practitioner.

CONTUSIONS of the abdomen are often more serious than those of the chest, for there is less power of resistance. We have already seen that death may occur from a contusion of the abdomen too slight to show a mark of ecchymosis or a serious injury internally. This has been attributed by some to an effect on the solar plexus or reflexly on the cardiac plexus causing a fatal inhibition. Lutaud and others have expressed the doubt whether the cases reported by Travers, Allison, Watson, Cooper, Vibert, and others were carefully examined, and have inferred that some visible organic change must have been present. Some such cases, however, have been examined with especial reference to this point, and no physical injuries and no other cause of death has been found elsewhere. There is no ground, therefore, for a jury to doubt that a contusion of the abdomen was the cause of death because there are no visible marks of injury.

Again, it is a well-known fact that blows severe enough to cause rupture of the abdominal viscera may sometimes leave no trace of violence in or on the abdominal wall. On the other hand, it must be remembered that effusions of blood may be found post mortem in the sheaths of muscles without indicating violence, so that blood may be found effused in considerable quantity in and around the abdominal muscles without violence having been done. In such cases, therefore, we should note whether abrasions or ecchymoses of the skin are absent or not. If they are absent and there is no other evidence of a blow, the medical witness should hesitate to attribute such an effusion of blood between the muscles to an act of violence.

As in the case of the chest, so wounds of the abdomen are serious, as a rule, mainly as they involve the contained viscera. The viscera may be wounded by a penetrating wound or by rupture, and the fatal result is due sometimes to internal hemorrhage or to shock, but generally to secondary septic peritonitis, which may be fatal in a few hours or only after days or weeks. Occasionally wounds of the abdominal viscera undergo spontaneous cure without surgical interference and with or without medical treatment. But as a rule they are fatal unless they receive proper surgical treatment. A wound of the abdominal wall may be penetrating without wounding any of the viscera. Such wounds may be fatal if they are infected, otherwise they usually heal readily and without danger unless they are extensive and the abdominal contents are exposed to the air. The gravity of penetrating wounds varies somewhat with the particular viscus or viscera injured. It is well not to examine wounds of the abdomen by the finger or probe too freely, unless a laparatomy is anticipated in case the wound is penetrating; for a simple wound or penetrating wound without wound of the viscera may thus be infected. A sufficient examination to diagnose between a simple and a penetrating wound of the abdominal wall is necessary.

RUPTURE OR WOUNDS OF THE ABDOMINAL VISCERA.

THE LIVER is most often wounded of any of the abdominal viscera, with the possible exception of the intestines, because of its size, and it is most often ruptured partly because of its size, but mostly owing to its friable consistence. Such injuries most often involve the right lobe, as it is much the larger of the two principal lobes. The anterior surface and inferior border is the most frequent site both of wounds and ruptures of the organ. Ruptures rarely pass entirely through the organ, but are generally not more than an inch or two in depth. They are usually directed antero-posteriorly or obliquely, rarely transversely, and the lacerated granular edges are not much separated as a rule (see Fig. 21). Rupture of the liver may be due to a blow, crush, or fall, or even to sudden muscular action if the organ is large and fatty. Thus Taylor[1] relates the case of a woman who died after child-birth of uræmic convulsions, and in whom there was quite an extensive hemorrhage into a subcapsular rupture of the liver, apparently due to violent muscular contraction. As we have already seen, the liver may be ruptured without the abdomen showing the marks of external violence. Rupture or wound of the liver is one of the causes of the fatality of wounds and injuries of the abdomen. The fatal result may be and often is due to hemorrhage; in other cases it is due to shock or the occurrence of peritonitis, though normal bile does not cause a septic peritonitis. Wounds of the liver heal readily and hemorrhage is arrested at once, as a rule, by the approximation of the edges. There may be little blood in and about the wound, but it collects in the right iliac region or in the pelvis and is not wholly coagulated. Unless the wound or rupture involves the vena cava, portal vein, or a large branch of either of these, the hemorrhage is apt to be slow and the victim may survive hours or even days, except for active exertion or repeated violence. Two cases illustrating the slowness of the hemorrhage have occurred in Guy's Hospital. In one[1] the man, showing no urgent symptoms at the time, was sent away, and died a few hours later in a police-station. In this case the liver was ruptured nearly through its thickness, and a basinful of blood had been effused, causing death. In the other

---

[1] "Med. Jurisprudence," 11th Amer. Ed., 1892.

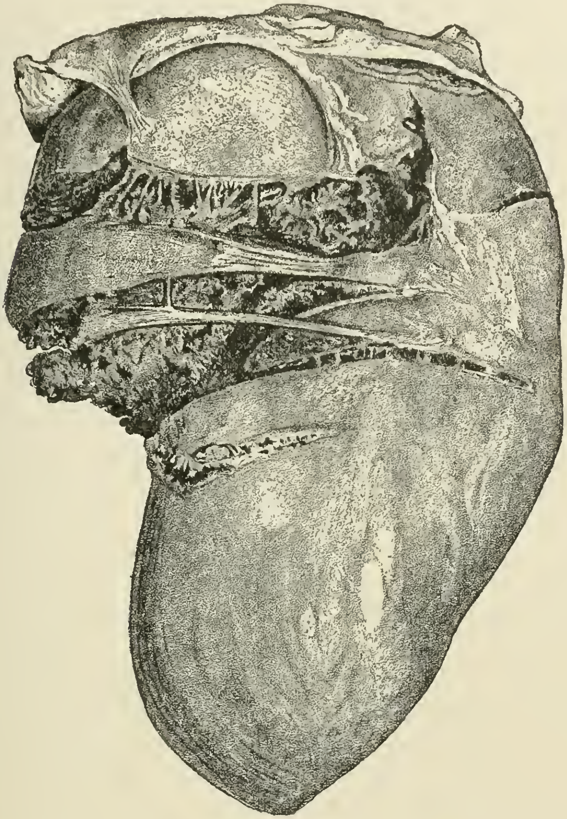


Fig. 21.—Ruptures of the Liver from a Fall from a Considerable Height, causing Immediate Death.

---

[1] Med. Times and Gazette, 1864, ii., 527.

case,[1] which occurred to Wilks, the patient survived the accident ten days. Taylor[2] cites a case which was reported to have ended fatally eight years after the accident. As a rule the injury is fatal, without treatment, within forty-eight hours. When it is not immediately fatal the victim of a rupture or wound of the liver can usually walk about, and may be capable of more or less severe muscular exertion after the injury, though the fact of such exertion has sometimes been used by the defence to prove that the rupture was not due to the particular violence in question.

Wounds and ruptures of the gall-bladder result in the effusion of bile. Rupture of the gall-bladder with the effusion of bile causes septic peritonitis only when the bile is abnormal, and is fatal in this way and not from hemorrhage. Rupture of the gall-bladder may be favored by the presence of gall-stones, but the result is still attributable to the injury.

SPLEEN.—Ruptures of the spleen may be due to a bruising violence in this region, and here too the skin may not show the marks of the contusion, though this fact is still employed by the defence to try to disprove the connection between the injury and the result. It is important to remember, from a medicolegal point of view, that an enlarged and softened spleen may be ruptured from a comparatively slight muscular exertion. This might occur in a sudden movement to avoid a blow, and the charge of manslaughter might be affected by the mode of the production of the injury and the previous abnormal condition. Only direct violence is liable to rupture the healthy normal spleen. Rupture and wounds of the spleen may be and generally are fatal from hemorrhage, owing to the vascularity of the organ; more rarely they are fatal from shock. Peritonitis is not a result to be expected.

The hemorrhage accumulates in the lower and left side of the abdomen or in the pelvis, and coagulation is imperfect if present at all.

KIDNEYS.—These are occasionally ruptured from violence, but more often from accident. Wounds of the kidney are rare, owing to the depth from the surface at which they lie. They are more accessible from behind. A wound of the kidney from behind is generally extra-peritoneal unless it perforates the organ;

---

[1] Med.-Chir. Rev., 1836, p. 296.

[2] "Med. Jurisprudence," 11th Amer. Ed., 1892, p. 347.

not so a wound from in front. Accidents in which the lumbar region is forcedly flexed are most apt to be followed by injury to the kidney. The injury may cause no prominent symptoms, but usually lumbar pain and tenderness, frequent micturition and hematuria, and in severe cases the symptoms of hemorrhage and shock are present. The injury may be speedily fatal from hemorrhage or collapse, or more slowly fatal from peritonitis, when the peritoneum is involved, from abscess and septic infection, or from uræmia if the other kidney is diseased. Slight injuries are generally recovered from. As is the case with the liver and spleen, so after injuries of the kidney the victim may walk about, etc., unless there is copious and immediate hemorrhage.

THE BLADDER may be wounded directly through the hypogastrium, vagina, or rectum; it may be punctured by a broken fragment of the pelvis, especially the os pubis, or it may frequently be ruptured by blows, crushes, or falls. The latter accident occurs especially where the bladder is distended. The bladder may also rupture spontaneously from over-distention, which may or may not be favored by disease of the bladder wall. Medico-legally the question may arise whether the rupture was spontaneous or due to injury. In this connection it should be remembered that the injury may leave no external mark of violence, and a case is recorded in which the bladder was ruptured by a fall in wrestling; but the question can be determined only by an examination of the bladder. If the wall of the bladder is thinned by the pressure of a calculus or from other causes, or if it is weakened by tubercular, syphilitic, or carcinomatous deposits or ulcerations, it may be spontaneously ruptured from slight distention or a slight degree of violence may rupture it. If violence has been employed it is responsible for the rupture, though the diseased condition may act as a mitigating circumstance; not so a distended bladder, as the latter is not abnormal. In spontaneous rupture from over-distention without disease of the bladder wall, stricture, hypertrophied prostate, or some such condition must be present to account for the over-distention. Spontaneous rupture of the bladder can, therefore, only occur when either disease of the bladder wall or obstruction of the urethra is present. No condition excludes rupture from violence. If there is an injury followed by the symptoms of rupture of the bladder and death and the bladder and urethra are healthy, there can be little doubt that death was due to the injury. Wounds or rupture of the bladder may be extra-peritoneal or intra-peritoneal. Rupture from disease of the bladder wall occurs at the site of the diseased and weakened spot, which is most often at the base of the bladder. Rupture of the bladder from violence occurs most often on the postero-superior wall, running downward from the urachus, in which case the peritoneum would be involved. A punctured wound of the bladder wall may be so minute that the leakage is very slow and the customary symptoms may be obscured, or the opening may be valvular in character, perhaps allowing escape of urine only when the bladder is not distended. The *symptoms* consist of pain, inability to micturate, and the presence of blood in the little fluid which can be drawn by a catheter. Fluid injected is not all returned and the bladder cannot be distended. After a time varying from a few hours to a few days, depending upon the size of the opening and the condition of the urine, peritonitis or peri-vesical cellulitis is set up, the former being generally fatal, the latter not necessarily so. Prompt surgical treatment may save the patient's life by avoiding peritonitis. Extra-peritoneal ruptures are far less dangerous than intra-peritoneal, as in the former case cellulitis and abscess in the cellular tissue around the bladder, which may subsequently be treated by operation and drainage, take the place of peritonitis in the latter case, for which prevention is the only safe treatment. In extra-peritoneal rupture death, if it occurs, is generally due to sepsis; in the intra-peritoneal variety it is due to peritonitis. These cases of injury to the bladder may die suddenly and speedily from shock, or from peritonitis in three to seven days, or not until fifteen days or so. In punctured and incised wounds the urine escapes more slowly, peritonitis develops less early, and death is longer delayed. Hemorrhage in injury to the bladder is not usually serious; the blood is found partly in the bladder, partly in the pelvis, where the fluid extravasated by peritonitis is also found. The victim of a wound or rupture of the bladder may often walk about for some time after the injury.

STOMACH AND INTESTINES.—Punctured wounds, or, more rarely, incised wounds of the abdomen may involve these organs, or they may be ruptured by blows, crushes, and falls, or from disease. Stab-wounds of these viscera may be multiple from a single stab, the instrument traversing one coil, perhaps, and then wounding others, though this is less often the case than with gunshot wounds. Ruptures too may be multiple, though less often so than wounds. The ileum is most liable to rupture, though several cases of rupture of the jejunum are on record. Like the bladder, the stomach and, to a less extent, the intestines are more liable to be ruptured when distended. Ruptures of the stomach or intestines are seldom attended with much hemorrhage, while wounds may occasionally cause a serious and fatal hemorrhage from the wounding of a large blood-vessel. The principal danger lies in the leakage of the contents of the stomach and intestines, which sets up a septic peritonitis. This may sometimes become localized and go on to spontaneous cure, though as a rule it becomes general and is fatal. In such cases early operation may avoid the fatal peritonitis. A punctured wound may be so small as to be closed by the mucous membrane and the contraction of the muscle fibres, avoiding the escape of the contents of the gut. Or a wound may not entirely penetrate the wall of the stomach or intestines, which only gives way some days, perhaps, after the injury, though the injury is entirely responsible for the delayed result. These injuries are sometimes fatal immediately or very speedily from shock, while in other cases of very extensive injury there may be almost no shock and the victim is aware of no serious injury. It is an important point, medico-legally, to remember that spontaneous rupture of the stomach or intestines may occur from ulceration due to disease. This can be determined by a careful examination of the wall of the stomach or intestines at the site of the rupture. A slight injury may also cause rupture if the wall of the gut is weakened by disease, as the disease causes greater liability to rupture. Here too it is to be remembered that a severe injury causing rupture may leave no mark of violence on the abdominal wall. The power of walking or other muscular exertion after such injuries of the stomach or intestines is not infrequently preserved, as recorded in numerous cases.[1] The prognosis in such injuries of the stomach and intestines is always extremely grave.

---

[1] Lancet, 1872, ii., p. 10.

INCISED, PUNCTURED, AND CONTUSED WOUNDS OF THE GENITAL ORGANS.

These are not common as medico-legal cases. Self-castration or mutilation is sometimes practised by lunatics, idiots, or even intoxicated persons. Thus a man who, while intoxicated, cut off his genital organs and died the next day from the effects of hemorrhage was seen by Demarquay.[1] Circumcision in infants is also sometimes fatal from phlegmonous inflammation.[2]

Incised, lacerated, or contused wounds of the female genitals may be fatal from hemorrhage from many small vessels. Deeply incised wounds of the female genitals proves wilful and deliberate malice; accident is almost out of the question and suicide is improbable in such cases. But we sometimes have to determine between accidental, self-inflicted, and homicidal wounds of these parts, as accidental wounds may occasionally resemble those made by design and so may furnish more or less difficulty unless all the circumstances are known. Thus Taylor[3] relates the case of a child in whom a sharp-pointed stick entered and passed through the posterior wall of the vagina as she fell from a tree. The stick was removed by a woman, and the child died in a little over a day from peritonitis. Unless the circumstances were known, this case might have caused suspicion of homicide.

Lunatics, idiots, and drunkards sometimes inflict on themselves wounds unlike ordinary suicidal ones.[4] In other cases the various points we have enumerated in a previous section to distinguish between suicide, homicide, and accident may be applied to solve the case.

Contused wounds, such as kicks, etc., of the female genitals may be fatal from hemorrhage due to the laceration of the parts.[4] Like the wounds of the eyebrows, contused wounds of the vulva may sometimes resemble incised wounds owing to the sharp bony surfaces beneath. Careful examination allows a discrimination to be made from incised wounds. If hemorrhage occurs a long time after the alleged violence, it is probably due to natural causes, especially in cases of metrorrhagia, etc. It may be alleged in defence that contused wounds of the female genitals were inflicted post mortem, but besides the other features which, as we have already seen, help to distinguish between ante-mortem and post-mortem wounds, we may add that kicks and other contusions of the vulva, if fatal, are so from hemorrhage or effusion of blood, and no post-mortem hemorrhage is enough to cause death.

---

[1] Lancet, 1870, ii., p. 471.

[2] See Taylor, "Med. Jurisprudence," 11th Amer. Ed., 1892, p. 348.

[3] "Med. Jurisprud.," 11th Amer. Ed., 1892.

[4] See Taylor, "Med. Jurisprud.," 11th Amer. Ed., 1892, p. 351.

INCISED, PUNCTURED, AND CONTUSED WOUNDS OF THE EXTREMITIES.

These may be fatal if a large blood vessel or vessels are opened, or sometimes if a compound fracture or wound of a joint becomes infected. They may also in some cases be fatal from shock, from the severity of the injury. As a rule they are the cause of civil suits, not of criminal ones. The various injuries may cause disability for a longer or shorter time, or even permanently, and more or less deformity may also remain. This may be the case with fractures, especially if they occur near the joints, in which case great caution should be exercised in giving an opinion or prognosis. It is a common mistaken idea of the laity that a fractured or dislocated limb can be made in every case as good as before the injury. On the contrary, they not infrequently leave a slight deformity and impairment of function, even under the best treatment. Dislocations may also leave a lasting disability or weakness, often owing to the carelessness of the injured person.

Wounds of an artery or vein, or both, may result in an aneurism or an arterio-venous aneurism. Wounds of nerves may cause paralysis and anæsthesia of the parts supplied. Wounds of muscles or tendons may cause weakness or complete loss of motion of particular joints. Wounds of the soft parts, if infected, may lead to cellulitis and phlegmonous inflammation, which may result in much injury. Wounds of joints, if penetrating, are serious, for without the proper treatment they may result in suppuration in the joint, disorganization of the joint, and final ankylosis. Before the use of antiseptic treatment such wounds were not uncommonly fatal. Fractures, simple or compound, or contusions of bone especially in young subjects, may be followed by osteo-myelitis and its consequences, which may require a long time for recovery after the fracture is entirely recovered from, and a still longer time before the limb can be used. These and many other of the various results of wounds and injuries of the extremities, causing deformity or disability, or both, can often be cured or improved by surgical treatment or operation.

THE MEDICO-LEGAL CONSIDERATION

OF

GUNSHOT WOUNDS.

BY

ROSWELL PARK, M.D., LL.D.,

Professor of Surgery in the University of Buffalo; Attending Surgeon to the Buffalo General Hospital; Member of the German, Italian, and French Surgical Societies; of the International Society of Surgery; of the American Surgical Association; of the New York Academy of Medicine, etc.

GUNSHOT WOUNDS.

GENERAL CONSIDERATIONS.

FEW medical men there are who have long engaged in practice who have not been compelled to take part in some medico-legal controversy in cases of accidental or alleged homicidal gunshot wounds. So soon as death occurs the surgeon ceases to work as such, but may continue to work as a medical jurist, and in preparation for this event must be ready to answer any questions bearing upon the case which, though possibly ridiculous in surgery, are or may be necessary in law. He may be called upon to testify as to the precise nature of a wound inflicted upon the body of a man seen before or after death; as to the means by which it was inflicted; whether the purport was suicidal or homicidal; how much blood was lost; whether the weapon was near to or at a distance from the body when fired; whether it were possible that the deceased could have fired it himself; whether after the reception of the wound the person could have moved or performed any act—in other words, whether death was instantaneous. He may be asked also as to genuine or spurious blood-stains, whether genuine blood-stains were human or from some other animal; whether possibly they were from the body of the deceased. He will be expected to tell from what direction the bullet or missile was fired; which the wound of entrance and which of exit, and many other things possible concerning the circumstances under which death occurred. It is unnecessary to state that questions of this nature call not only for conventional surgical skill, but for the highest degree of shrewdness and general information, as well as sometimes for expert knowledge with regard to small-arms and their ballistics.

It has been well said that the first duty of a medical jurist is to cultivate a habit of minute observation. When this is combined with a knowledge of what the law requires and with the results of a technical education, he will be able to meet all or nearly all of the scientific questions which may be asked of him. A learned judge once said that "a medical man when he sees a dead body should notice everything." Certainly he should make a minute scrutiny of the body to note whether there are upon the dress or hands of the deceased marks of blood, or whether blood-stains are noted in different parts of the room; whether the body or any part of it is cold or warm; whether the limbs are cold or rigid or pliant, since by these means the accurate date of death may be more accurately determined.

EXAMINATION AND DESCRIPTION.

In determining facts attending a suspicious case of gunshot wound, there should be noted, if known, 1st, the exact time of death, as well as of infliction of the wound; 2d, location and attitude of the body; 3d, condition of clothing; 4th, anything of importance in its environment; 5th, external appearance of the body, as well as state of countenance; 6th, exact description of all marks of violence and of blood-stains; 7th, the presence of cadaveric rigidity and the surface upon which cadaver has been lying, as well as its age and condition of general nourishment; 8th, time when deceased was last seen alive or known to have been alive; 9th, time after death at which examination is made; 10th, all physical circumstances corroborating or arousing suspicions of suicide or homicide; 11th, account of an accurate internal post-mortem examination, in which direction of the bullet or missile is noted, along with a careful description of parts disturbed or injured in its course, large vessels or nerves cut across, effusions of blood, and in every way as accurate a description as possible of the exact damage done. To this also should be added a minute scrutiny of other parts, in order to establish clearly that death was due to the alleged injury, or on the other hand that it may have resulted from natural causes, and that the injury in question was only a consecutive and contributing cause. Especially should there be examined those organs in which occur the most common causes of death, namely, the brain, the heart and great blood-vessels, and the viscera. Moreover, if an operation has been performed the post-mortem examiner should be prepared to speak with reasonable positiveness as to whether said operation was, in the first place, necessary if life were to be preserved, and, in the second place, whether death were due to the injury proper or to the attempt to save life thus made necessary. For the determination of all this, obviously the best time for the performance of the examination is the earliest possible moment after death. Nevertheless, bodies are sometimes exhumed for this purpose, and much information is obtainable even after a considerable interval of time.

If death has been caused by a bullet which has not passed through the body, but lodged, it should by all means be obtained, since evidence of the greatest value may inhere in it. Moreover, in first noting the position of the body, the direction of the wound, or the location of a blood-clot upon the floor or clothing or elsewhere, may indicate to the surgeon or other astute person the point at which the bullet may be found concealed or buried in some soft or hard object. This bullet should be recovered, if possible, at all events, although if taken from the body itself the evidence it conveys may possibly weigh more heavily than if removed from some object outside the body. The exact number of gunshot wounds with a minute description and location of each should be committed to paper at once, as well as any statement, if at all reliable, concerning the number of shots fired, since valuable deductions may be reached as to the number of bullets which have passed through or which have lodged within the body. It is well sometimes, also, before dissecting out the bullet-wound, to insert first a stiff and then a flexible probe or something which shall, if possible, follow the bullet-track, since occasionally a question comes up of the direction in which it was fired. Even though surgeons well know that such questions are impossible of satisfactory answer, owing to the manner in which a bullet is diverted in its course by the various tissues of the body, it will nevertheless create a good impression as to the thoroughness and exactness of an examination should it be brought out, in answer to questioning, that this had been done. Many an excellent surgeon has been surprised upon the stand by the question from one of the counsel as to whether he knew that some certain writer had stated that it was always well, in trying to determine the course and direction of a bullet, to put the patient or the body, as the case might be, in the exact position in which it was when the shot was fired, providing this be known. The accomplished surgeon knows that this is a matter of very trifling import, but the witness' status will be much better established with the jury if he can show himself familiar with this possible method of examination.

When a suspected person is brought before a magistrate, accused of homicidal attempt, it is very likely that the judge will require a written statement or opinion from the surgeon in attendance as to the extent and danger of the victim's injuries, and especially as to whether these are of a character dangerous to life. The meaning of these words is left entirely to the sagacity of the surgeon. A mere naked declaration of this fact is insufficient. He must, if called upon by the court, give his grounds for his belief, and these may be rigorously examined by counsel. He will also probably be asked as to the presumable duration of life and possibly the effect of operation. Thus the prisoner's immediate liberty or restraint may depend upon the surgeon's words. Perhaps the only advice which can be offered here is to qualify between injuries directly dangerous to life and those in which life is endangered merely by possible complications, such as sepsis, gangrene, etc. Still, aside from wounds which are either fatal or may be nearly completely recovered from, there is another quite large class of those causing grievous bodily harm in which it is a question for the jury always to decide what was the intent of the accused. A medical witness may thus in such a case be of great assistance to the court by giving an account of the injury devoid of technicalities, and of its possible consequences. It should also always be stated, if known, whether the patient was under the influence of liquor or any narcotic at the moment of injury.

In the examination of wounds either of the living or dead body, it should always be determined for medico-legal purposes whether there is about them fluid or coagulated blood or ecchymosis, that is, livid discoloration of the skin from effused blood. The color of the ecchymotic spot will give a valuable clew as to the time between the infliction of the wound and death. Putrefaction of such a wound must not be mistaken for gangrene. In giving reports on such cases care should be taken to distinguish between facts and inferences. In fact, the inferences had better be kept unreported or confined to a separate statement.

Should there be any possible suspicion of a combination of poisoning and gunshot wound, the stomach-contents should be carefully preserved and sealed up in the presence of witnesses before turning over the same to the analytical chemist, whose receipt for the package, with a careful description of the same, will probably have to be placed in evidence. Any fact on the condition of the stomach with regard to digestion is always worth noting. In the case of Reg. *v.* Spicer (Berks Lent Assizes, 1846) a most important point hinged on the examination of the stomach. The body was found at the foot of a stairway. The prisoner stated that after he and his wife had had their dinner he heard a fall. The woman had died instantaneously and the death occurred about the dinner-hour. Upon examination the stomach was found empty, without a trace of food. It was, therefore, clear that a part at least of the prisoner's story was untrue.

Evidence as to whether the wounds were superficial or deep may be of value. If the edges are swollen or large, or if granulation or cicatrization have commenced, it is evident that the person must have lived some hours or some days after their reception. The same is true of suppuration, adhesion, or gangrene. It must also be remembered in this connection that very few gunshot wounds will show much change in less than ten or twelve hours save that due to the extravasation of blood. Should the question come up as to whether a gunshot wound had been inflicted before or after death, we may remember the principal characteristics of a wound inflicted during life, which are more or less eversion, more or less hemorrhage with diffusion of blood into the tissues, and the presence of clots. In a wound made after death little or no blood is effused, unless it come from some vessel very near the surface, in which case it will be venous in character and will not coagulate as does that which is poured out of a wound in the living. The track of the bullet also will not be found filled with coagula. In these respects a little will depend upon whether the body has lost its animal heat or not. The gunshot puncture of a divided artery in a dead body will present a very different appearance from one inflicted before death, even though it be the cause of death.

Bleeding after death is exclusively venous, and there does not occur extravasation of blood in the cellular tissues, nor does it coagulate. Questions of this character come up sometimes in the case of multiple wounds or injuries, and it is, at times, of importance to be able to determine whether the assault or injury has been continued after death. Changes in color of an ecchymosed spot rarely begin until after the expiration of twenty-four hours, when its dark margins become lighter, and as time goes on the whole area passes through successive shades of violet, green, and yellow; its area may also increase sometimes to remarkable proportions, but the central portions are always darker than the periphery, the darkest spot corresponding to the centre of violence. Ecchymosis is longer in disappearing in the old than in the young. Its various features also will vary a little in accordance with the tissues bruised.

Davis has shown that a ball striking the body obliquely may simply contuse the parts or cause a subcutaneous fracture. Other statements of his are also of interest (*Indian Med. Rec.*, Aug. 1st, 1898; Gould's *Am. Year Book of Surgery*, 1900, p. 215). The contusion effects of abdominal gunshot wounds have been exhaustively set forth by Seliger in *Friedreich's Blätter*, July, 1898.

Gunshot wounds pertaining to spurious suicidal attempts are usually found not to involve vital parts, while they will have most of the characteristics of injuries inflicted from a weapon near at hand. The skin or the clothing will show powder-marks, and if a wad is a feature of the cartridge used, it may be found in one place or the other. In these cases there is also relatively more laceration and bruising, while sometimes the hand which held the weapon may be blackened or burnt by the discharge of the same. Self-inflicted wounds, in other words, must necessarily partake of the character of near wounds.

EVIDENCE FROM THE SITUATION OF THE WOUND.

It has been generally noted that suicidal wounds are for the most part confined to the front or lateral parts of the body; gunshot wounds of this character being found usually in the region of the heart, the face, and the temples. The presence of an injury to these parts is not necessarily indicative of suicide, but the existence of such injuries in other parts of the body is at least negative evidence of homicidal attempt. Moreover, Orfila has observed that it is not so much the situation as the direction of the wound which gives evidence for or against the presumption of suicide. The question has been raised whether it were possible to have a gunshot wound without external evidence. There has been recorded more than one case where a bullet entering through the open mouth has penetrated the brain without passing through the vertex of the skull and has killed instantly without leaving any external mark.

It is very necessary to establish, if possible, the direction of such a wound, and this may be coupled with a knowledge of the right-handedness or the left-handedness of the person who inflicted it, or may shed light in this way upon some personal peculiarity which may lead to the detection of the guilty person. Thus it is said of Sir Astley Cooper that in one instance he remarked that a certain wound could not have been inflicted except by a left-handed person, and that his observation led to the detection of the murderer. It has been stated that for the detection of the weapon or instrument used it should be placed first in one hand of the deceased and then in the other, while the other extremities are so manipulated that it may be clearly determined whether suicidal attempt were possible or no. There is ordinarily little difficulty experienced in distinguishing suicidal from accidental wounds. In the former case extraneous signs and circumstances point more clearly to the intent of the deceased than do, perhaps, the peculiarities of the wound itself. This is to be settled mainly by the evidence of those who find the body; in other words, by circumstantial evidence.

In suicides ordinarily one wound only is met with. At any rate, probably one only that has destroyed life. Consequently the presence of several wounds, each of which was necessarily fatal, constitutes almost conclusive evidence of murder, the strength of the same depending upon the necessary fatality of more than one of these. Thus it is hardly conceivable that a suicide should shoot himself through the heart and through the brain; the coexistence of two such wounds would be almost conclusive of homicide. The existence of multiple wounds is a rather strong presumption of insanity or drunkenness of the person who inflicted them. Men who kill when under the influence of liquor not infrequently inflict injuries enough to be several times fatal.

The coexistence of wounds made by cutting weapons, as well as firearms, is not unknown. These are occasionally suicidal, ordinarily they betoken murderous attempt. If suicidal the deceased will ordinarily be found to have been a lunatic.

But evidence is to be obtained also from signs and circumstances separable from the wound itself. Thus the position of the body may be such as to invalidate the theory of accident or suicide. The position of the weapon, too, is something to be noted with great care. Whether, for instance, this be firmly held within the hand of the corpse, or whether it had been simply placed there after his death; whether it be found where it would seem to have been most naturally dropped after its discharge, or found somewhere where it could scarcely have been placed or thrown by the deceased; whether it be found at such a point that it is clearly evident from other signs it could not have been dropped by the deceased, since death must have been caused too quickly for him to have traversed the intervening space.

EVIDENCE FROM THE WEAPON AND PROJECTILE.

Evidence of great value may be obtained often from the weapon itself. First of all, from the position in which it is found, as stated above; second, from a careful examination of itself. It should be noted whether there be any blood upon it, and whether this be so fresh as not to have caused any rust; whether it may possibly be so smeared with blood as to indicate a hand-to-hand conflict; or whether any part of the weapon may have been used as a club or bludgeon, as would be shown by the presence upon it of hair entangled in dry blood. When such blood is removed from the weapon it should be carefully examined with the microscope, since from the detection and identification of hair or fibres of fabric evidence of the greatest value may be adduced. Next it should be ascertained whether a weapon shows signs of having been recently discharged or whether it be evident that it could not have been so, and such determination of the time element as may be afforded by a study of this kind should be contrasted with that made after a study of the wound. If the weapon be a revolver or a repeating arm of any kind, it should be determined if possible how many cartridges or bullets have been fired, and whether at or about the same time, and this information should be compared with the evidences obtained from the body and from the room or locality in which the suicide or murder occurred. If, for instance, it be determined that three cartridges have been fired and but two bullet-wounds are found in the body, an examination of the room may show where went the third bullet. Next the calibre of the weapon should be noted and the weight of the ball which it discharged and its dimensions should be compared with any which may be found in or about the body. The weight of the bullets attached to cartridges of various sizes and makes is usually stamped upon the packages in which they are sold, or can readily be obtained from the makers of the same. A bullet taken from a body weighing after its removal more than do the other bullets undischarged in the weapon by which an injury is alleged to have been inflicted is rather presumptive evidence against the injury from that source.

Revolvers in general use vary in calibre from .22 to .45, with barrels from 2 to 8 inches in length. The better the weapon is made, and the more tightly it contains gases, the greater the distance to which it will throw powder grains. In repeating experiments the weapon should be in the same condition as that with which the shooting was done. If accumulated dust is blown out the effect on the target may be obscured.

The bluish stain of a bullet wound which is made by the lead of the bullet itself should not be mistaken for the powder burn; the former happens without reference to the distance of the weapon.

The best target for experimentation consists of a piece of white blotting-paper with fine sand behind it (Fish, *Boston Med. and Surg. Jour.*, Oct. 2d, 1884).

CAN A BULLET LOSE IN WEIGHT BETWEEN THE TIME WHEN IT LEAVES THE BORE OF A GUN AND ITS DISCOVERY IN A BODY?—Here springs up a question upon which some very interesting evidence has been adduced in different trials. To discuss this matter completely the question should be divided into two, the first being:

DOES A BULLET SUFFER LOSS OF WEIGHT DURING ITS COURSE THROUGH THE PIECE AND THE AIR BEFORE IT COMES IN CONTACT WITH THE BODY?—A personal letter received from Captain Charles Shaler, of the Ordnance Department of the United States Army, in reply to certain questions, tends to fully settle that a lead bullet suffers a certain loss of weight in the barrel due to the friction between the bullet and the bore; this is known as "leading" and varies according to circumstances. "Patching" the bullet is often resorted to in order to reduce the leading; lubrication is also practised. The fusing of a bullet takes place especially with lead bullets. A ball which has been partly fused in the bore will lose the fused portions in the bore or in flight, and will move irregularly on account of the resulting irregularity of form. A .45-calibre, 500-grain service bullet, lead alloyed with tin, was weighed without lubricant and was found to weigh 500.5 grains. It was then lubricated in the cannelures and was fired into a butt composed of three barrels placed end to end and filled with sawdust. The bullet was recovered, no lubricant being found in the cannelures, and reweighed, the weight obtained being 485.5. The loss of weight was, therefore, 15 grains or three per cent, some of which may have been due to the bullet penetrating the sawdust. A German-silver "jacketed" .30-calibre bullet, weighing before firing 231 grains, fired without lubrication, when recovered and reweighed was found to have suffered a loss of weight of one-half grain or one-quarter of one per cent. The other part of the main question is:

DOES THE BULLET LOSE IN WEIGHT IN ITS COURSE THROUGH THE BODY?—This is, of course, intended to pertain only to those instances in which there is no evidence of splitting or division of the bullet, and refers only to the effect of friction or attrition. June 5th, 1878, in Saratoga County, Mrs. Jesse Billings was accidentally killed by a bullet. Her husband was arrested and tried for murder. On the first trial he was acquitted. A second trial, however, was held, and some very interesting expert testimony was brought out on matters pertaining to these questions. The medical evidence is published in full by Dr. Lewis Balch, of Albany, in the Transactions of the Medical Society of the State of New York for 1881. The rifle from which the bullet was supposed to have been fired was found in a well, and was sworn to have belonged to Jesse Billings. In it was found a cartridge of the type known as the Commercial Long No. 44. This gun became an important factor in the case, and most of the evidence as to whether it was the weapon with which the murder had been committed was referred to the medical experts. The defence in the first trial claimed that all the lead fired was found in Mrs. Billings' head. On the second trial the same claim was not made, but that it was a smaller bullet than a .44 and its weight less than 220 grains; that in consequence this rifle could not have been that from which the shot was fired, for it only called for a .44 ball, and that it would have thrown a bullet with such force that it must have gone entirely through the head. They further claimed that powder-marks and grains of powder were found in the window-sash, showing that the weapon was fired near the window, and that the hole in the glass was not large enough to admit a full-sized .44 ball. The verdict was mainly won upon these statements. A question for the medical experts to answer was, what would be the effect upon the skull of a .44-calibre ball fired from a Ballard rifle, the ball weighing 220 grains and the charge of powder being 28 grains? also what would be the effect upon the ball? Experts from the Ordnance Corps and from the rifle factories were able to testify that the bullet found in Mrs. Billings' head was originally a .44-calibre ball; also that its markings showed the peculiar left-handed twist used in rifling this particular arm. The defence maintained that it could not have been a .44, claiming that the hole in the window-pane showed that. The original window produced in court was no criterion, since from repeated handling the hole made by the bullet had become enlarged and changed in shape. Both of the experts for the defence believed that the ball could not make a hole smaller than itself when passing through glass. This necessarily supposes that the ball after being fired is the same calibre as before, which, as shown above, is not always the case. So Dr. Balch fired forty-five rounds from the Billings rifle with 220 grains of lead and 28 grains of powder. The shots were fired through glass set in sashes, the glass being 28x13½, double thick and American make. The rifle was discharged at varying angles and at distances varying from two to seventy feet, and he obtained one shot where the hole made would not admit a full-sized ball. His summary was as follows:

Balls unable to pass through	1
Balls partly passed	3
Balls passed	18
Cartridge passed	21
Glass broken out	2
Total	45

Other rounds were fired from a Colt's navy revolver, old style, .36 calibre, at distances varying from ten to twenty feet. The holes made were so large that the barrels and ramrods could be passed without touching. The examination of the one instance noted above where the aperture in the glass was smaller than the ball is explained by Balch as follows: "A ball conoidal in form, passing with great velocity, strikes glass, penetrates, but does not break the glass at the point of entrance. The point struck is instantly disintegrated, and so rapid is the stroke that it has not time to call upon the surrounding particles for support; hence the smallness of the hole. As glass is made it varies in elasticity; some parts which are to be cut into panes cool faster than others. A bullet striking the portion of the glass which has cooled quickly strikes an object which will yield somewhat to the force; in doing this a hole will be made smaller than if that more brittle had been struck. Furthermore, all rifles taper more or less from breech to muzzle, that is, the muzzle will measure one or more thousandths or hundredths less than the breech. The bullet being forced through the narrow aperture yields to the pressure and becomes smaller. The gun under consideration was measured at the New York Armory, and found to be .44 at the breech or chamber and .423 at the muzzle. Considering these various facts, statements that a ball of known size will make a hole through glass smaller than the size of the ball when fired do not admit of doubt as to their verity. Some statements bearing on this same point contained in a recent letter from Captain Shaler, of the United States Army, deserve mention here. The following experiment was made in Washington by Captain Lyon in October, 1880:

"Noticing a statement in a newspaper to the effect that a ball fired from a rifle would, in passing through glass, make a round hole smaller than the diameter of the ball used, the following experiment was made:

"Service ammunition used, in a calibre .45 Springfield rifle to penetrate glass.

Time Fired.	Size of Hole made in Glass, inches.	Remarks.
1	0.570	
2	0.550	
3	0.600	
4	0.600	
5	0.575	
6	0.575	The frame holding the glass was placed 25 yards from the muzzle of the gun.
7	0.590	
8	0.620	
9	0.600	
Average size of hole	0.586	
Calibre of bullet	0.458	
Difference	0.125	

"From the above it will be noted that there is no uniformity in the size of the holes and that they all exceed the diameter of the bullet.

"These experiments were supplemented by some made recently in which a sash containing six panes of ordinary window-glass was placed at twenty-five yards from the firer and the glass was successively penetrated (a separate pane being used in each case) by bullets from a service .45-calibre Springfield rifle, a .30-calibre Springfield rifle, a .45-calibre Colt's revolver and a .22-calibre revolver. In every case the hole made was much larger than the bullet making it."

With reference also to the effect of a ball being smaller than its original diameter after it leaves the piece, Captain Shaler states: "All very compressible bullets forced by inertia lose a certain amount even though they also gain force by slugging. Forcing by inertia tends to shorten the bullet and increase the diameter, while slugging tends to lengthen the bullet and reduce its diameter. Whether the bullet is smaller after it leaves the piece depends upon the bullet used and the method of forcing employed."

To return to the Billings case, it was claimed that the bullet was also too small. It weighed 165 grains, 55 less than when it was fired from the rifle. Balch found in firing at human skulls, the subjects in all the trials but two being placed in a sitting posture, sometimes with a sash like the Billings window in front of the subject, that the ball lost lead in accordance with the resistance it met with and the amount of bone ploughed in its passage. These experiments conclusively prove that the weight of a ball taken from a body after being fired, it having traversed a bone in its flight, is by no means evidence of its weight before firing; in other words, a ball always loses some lead when passing through bone. With the same rifle as that produced at the trial he made a series of experiments in the dissecting-room, endeavoring to make a bullet enter the skull at the same point and in nearly as possible the same direction as in the case of the murdered woman. In six such experiments there were varying losses of lead, all the bullets used being the same general weight. In two trials the distance was but ten feet from the muzzle, yet more lead was lost than in any of the other four. The least loss recorded took place at the longest distance, thirty-five feet. This in part accounts for the loss of lead, for at ten feet the bullet has not acquired its greatest penetrating power, for he showed by experiment that a 220-grain bullet fired at a human skull will lose more lead than was missing from the Billings bullet, thus disposing of the question raised by the defence that a ball could not have weighed 220 grains before being fired.

Just how to account for the missing lead has never been clearly established. We have to remember that a few grains may be left in the bore of a rifle, especially if rusty; that in passing through glass another portion is lost, and finally it is scarcely conceivable that any bullet should penetrate an adult skull, especially in the neighborhood of the mastoid processes, without losing quite a perceptible percentage of its mass by friction.

It was also claimed by the defence that the ball taken from Mrs. Billings' head had been fired from a weapon of low velocity, which was held to account for the fact that the ball failed to pass out of the skull. The rifle when tested at the Government Arsenal showed a mean velocity of 999 feet per second. Had it been as high as was supposed by the defence, namely, 1,300 or 1,400 feet, the argument that a bullet driven with this force would always go through the skull would have more weight, but with the velocity found by actual test the energy of the ball was lessened to nearly one-half of that supposed. The bullet which killed Mrs. Billings did not pass entirely through the skull. It ploughed into the opposite side and broke before it a triangular piece of bone which broke the skin externally. This shows the resistance of external fascia against perforation. A study of the lines of fracture in this particular case proved very interesting, but perhaps would be somewhat irrelevant here. A measurement of the skull and of the bullet-track through it shows the former to have been of more than ordinary thickness and density, and the channel ploughed in the bone by the bullet along the base of it to have been nearly two inches in length. Dr. Balch gives the following conclusions to his very interesting evidence: 1st. A leaden ball passing through bone loses lead in proportion to the amount of bone traversed. 2d. If the petrous portion of the temporal bone be the part struck by the ball and struck squarely at the base, that portion of the bone is crumbled or broken in such exceedingly fine pieces as to defy restoration. 3d. That if the ball struck any part of the skull the petrous portion will be broken, but can be usually recognized and generally put together again. 4th. That a ball of given calibre fired through glass may make a hole enough smaller than the full size of the ball before firing to prevent an unfired ball of like calibre passing.

In all this kind of experimentation upon cadavers for the purpose of eliciting evidence by reproducing as nearly as possible ante-mortem injuries, we must not forget that Casper has strongly insisted that "it is extremely difficult to break up the organic cohesion of dead organs. . . . If we endeavor to fracture the skull of a dead adult we shall find that an amount of force which if applied in life would indubitably produce fissures if not fracture, or complete crushing of the skull, leaves the dead skull quite uninjured. . . . The most powerful blows struck down upon the body, laid down horizontally, were without result, and only after repeated violent blows were we able to produce perhaps one or a few fissures in the occipital or parietal bone, or in the temporal bone (squamous portion), and usually in the latter. We were unable to produce more considerable effects, such as complete smashing of the skull or fissures of its base, even in one single instance. The dead skull seems to have considerably more power of resistance, and after its removal fissures of the bone were more easily produced by similar blows" (Vol. I., p. 245). And again: "The result of my experiments on the dead body in regard to gunshot wounds could only be to make more complete the proof of the resistance of the dead corporeal tissues, in contradistinction to the tissues when alive. After I had already learned this peculiarity from my experiments with contused wounds, this peculiar resistent property was found to be confirmed in a most remarkable manner" ("Forensic Medicine," Vol. I., p. 271).

If the number of bullets known to have been fired, or, more important still, which have been found exceeds the number which could have been discharged from the weapon in question, a very large element of doubt and uncertainty is introduced which must be quieted by other and more circumstantial evidence. Should two different weapons be in question, it is very necessary to establish from which of them the bullets have been discharged. This can be done mainly by weight and evident calibre of the bullets, or some other peculiarity; possibly in disputed cases even by analysis of the metal.

Wounds by Shot-Guns.—In most of what has been said it has been supposed that the injury has been inflicted by an arm of the kind commonly described under the terms pistol, revolver, or rifle. Gunshot wounds are, however, occasionally inflicted with shot-guns and a charge of shot varying in size from small bird-shot up to that generally known as buck-shot. It is characteristic of such missiles that they separate after their discharge from the gun, and a determination of the degree of their separation is approximately a determination of the distance of the mark from the muzzle of the weapon. In suicide or accidental discharges of a shot-gun the muzzle is so near the body that the charge of shot acts very much as would a single bullet of the size of the bore of the gun, and near wounds thus inflicted, while necessarily large, have about them a minimum laceration and disturbance of tissue, so that perhaps only by their size could one say, viewing the wound alone, that the weapon used had been a shot-gun. On the other hand, at a distance of a few feet the shot begin to separate to such an extent that there is much more laceration of tissue, and after separation to an indeterminate, because variable, number of feet we get such marks as individual shot may make. This distance is indeterminate because it is predicated on the size of the gun, the dimensions of shot, and the weight of the charge of powder. The writer, for instance, has recently seen one case where the muzzle of the gun could not have been more than two feet away from the surface of the foot at which it was discharged, the consequence being a round and very slightly ragged hole through the mid-tarsal region from dorsum to sole.

Corin was able to produce experimental fracture of the ulna with small shot, at a distance of 12 metres (*Archiv. Anthropol. Crim.*, March, 1896).

It is possible for a single grain of shot to produce death. Such a case is related by Ollivier d'Angers; a thief scaling a wall received at a distance of fifteen paces a charge of shot from a fowling-piece; he fell dead immediately. The charge had struck him in the breast, centring over a space of three or four inches, but one shot had penetrated the aorta over the attachment of the sigmoid valves, and another had traversed the entire wall of this vessel.

Improvement in modern fire-arms has been rapid and changes numerous. Much that was formerly held true regarding gunshot wounds by military arms now requires revision; nevertheless the majority of homicidal wounds coming before civil courts now and in the near future will be made, as heretofore, with common black powder and unjacketed bullets. Even jacketed balls having unprotected or softened lead tips (the so-called *dum-dum* bullets) are spread on entering the tissues, and tear large holes, without necessarily producing explosive effects. On the contrary, protected missiles of small calibre and high velocity, while capable of great penetration, are relatively lacking in proportionally destructive power, as the experience of 1899 to 1901 in Cuba and South Africa has amply shown.

Brand and Powder-Marks.—A very important part of evidence in case of near wounds of gunshot character pertains to the powder-marks upon the clothing and skin. Naturally every one knows that when a weapon is discharged near a given surface there will be more or less powder-marking upon that surface, the same being due to particles of gunpowder which are incompletely or not at all consumed, and which are black because of the charcoal they contain; but the circumstances under which powder-marks of a given character can be inflicted are so extremely variable that no statistics or information of value in a general way can be given. Thus the fineness of the marks will depend upon the fineness of the powder, and the area covered and the depth of the marking upon the same upon the distance of the muzzle from the surface; and the only way to make out the exact distance of the muzzle from the surface at the time of the infliction of a given wound is to use the same weapon, if possible, with cartridges or charges out of the same lot as that used at the time of injury. Distances could, perhaps, be stated in round numbers, but their value would only be remotely approximate, and in a given case the best evidence is to be obtained by experiment with the fire-arm in question.

We must further distinguish between the *brand* and the tattooing; the former is produced by the flame of the discharge, the other by the powder grains. The area of the latter increases with the distance of the weapon up to the point when it begins to grow faint. In much lesser degree this is true of the brand. This is found rather above the bullet hole, because of the recoil; the tattooing all around it, but especially below. The brand is superficial and disappears; the tattooing is deeper and may remain for months (Fish, *l.c.*).

The distances at which these are observed differ so essentially, particularly with the new weapons and powders, that each style of one and variety of the other must be studied by itself. Consequently it is impossible here to give tables or any definite information. These matters must be determined for each case, if possible, with the original weapon, at all events with one of the same make. The spread of shot from a shotgun must also be determined experimentally under conditions repeating or simulating those of the original incident.

Ignition or burning of the clothing can only be produced by the flame of a weapon held very near it; in the case of a revolver probably not over ten inches. Cotton batting is more combustible than ordinary clothing. Ignition may result either from the flame or from burning powder grains or bits of wadding (Hall: "A Study of Gunshot Wounds with Reference to the Proximity of the Weapon at the Time of Firing," *Boston Med. and Surg. Jour.*, 1895, Nov. 14th, p. 484).

Dimensions of Perforations.—At different times a great deal of weight has been attached to the dimension of the perforation through such objects as wood, glass, or even through the bones of the body, made by the bullet which is supposed or known to have destroyed life. Wrong inferences have been drawn sometimes from a study of undischarged bullets or cartridges similar, at least before firing, to that which has been taken from a given body. It has been stated, for instance, that such a bullet was too large to have passed through such an aperture or to have made such a hole, or that it was so much smaller than a certain hole that it was not the particular missile which made that perforation. Upon this matter has hinged a great deal of uncertainty and consequently a good deal of study. The size of opening which a bullet of given calibre will make through wood depends upon the distance of the weapon, the firing charge, the velocity of the bullet, the extent to which its shape has been altered by passing through the given barrier, by the heat of the explosion, by the impact of the air upon the heated and consequently softened metal, and by the density and thickness of the wood, as well as by the resistance which it may have offered mainly from its being fixed in place or movable. There is, however, ordinarily less question about the size of a similar hole through a piece of glass or bone. It is generally supposed that a bullet passing through a window-pane will shatter it. This depends, however, mainly upon the perfection of fixation of the glass in its resting-place. If for purposes of experiment panes of glass be tacked into a shutter and bullets be fired at them from varying distances, they will be practically invariably shattered. It is, however, quite different if the pane of glass be firmly fixed in a frame by means of putty which has become old and hard, and especially if the window-frame itself be closely fitted in the casing. Under these circumstances a bullet will often make a clearly punched hole, or one with very few radiating lines of fracture. Experiment, therefore, to secure evidence should be made under circumstances exactly parallel to those which necessitate such evidence.

EVIDENCE FROM EXAMINATION OF THE DEAD BODY.

Fractures.—Considerable evidence of great interest with respect to the effect of a bullet-wound upon the skull and the possibility of fractures being produced at the base by *contre coup* will be found in the statement of the case of The People *v.* Elisha B. Fero, published by Dr. Charles T. Porter, of Albany, in the *Journal of Psychological Medicine*, April, 1870. Mrs. Fero was murdered while in her bed and was found to have been bruised about the head and body, her husband claiming that the deed was that of a robber who had attacked them both. He was found with slight bruises or scratches about the face and black marks as if from burnt powder between the middle fingers of his right hand. The first autopsy appears to have been carelessly made, but a flattened conical ball weighing twenty-six and one-half grains was found lodged in the middle of the right cerebral hemisphere. It had not gone completely through the brain. Its base fitted the shells of the metallic cartridges used in Fero's revolver. Eight days after death a second examination was made, after which the head was removed and preserved in 95% alcohol. A theory of the prosecution was that Mrs. Fero was murdered by her husband; that he shot her, as well as struck her numerous blows upon both sides of the head and its front and back with some broad, heavy, and elastic body, making fractures found on autopsy. Not the least interesting part of the testimony is that referring to the condition of tissues alleged to have been bruised after long preservation in alcohol. The expert testimony in this case appeared to show that such fractures as were found, without reference to the fact of external bruises, were due to the unskilful manner in which the skull-cap was removed. In this connection it is well right here to emphasize the fact that fresh fractures can be produced in the skull by too forcible or injudicious efforts to remove the calvarium when making autopsies, or that fractures previously existing can be extended or complicated in the same way. Shaw in his "Manual of Anatomy" says: "The question whether there has been a fracture of the cranium previous to death is sometimes more difficult to decide than a person not accustomed to make dissections might imagine. If the fracture has occurred immediately before the patient's death, there will be found coagulated blood upon the bones and in the fissures. If the patient has survived for some time, there will be marks of inflammation and, perhaps, pus in contact with the skull, but if a fracture has been made in making the examination, which sometimes happens in even very careful dissectors' hands, the blood in the fracture will not be coagulated, nor will there be any effusions around the portions. In Beck's *Medical Journal*, Vol. XXII., p. 28, Mr. Alcock some time since stated in a public lecture in London that he had known a fracture of the base of the skull produced by the awkward and violent tearing of the upper portion by the saw in penetrating enough to divide the bones, and this to be mistaken by the inexperienced operator for fracture of the skull producing death. Being a medico-legal case, it might have led to melancholy consequences had not the error been detected by an observer." That an extensive and often complicated fracture by *contre coup* can occur as the result of gunshot injuries of the skull is a fact well known to all surgeons of experience and laid down in all text-books and illustrated in all large museums.

In view of these well-known facts, it would always be well to insist in cases of this kind that the saw alone should be used and not the hammer nor the chisel. When a cranial bone is fractured blood is poured out from the ruptured vessels, as is always the case with any bone. Its amount varies indefinitely with the number and size of the ruptured vessels, the activity of circulation, the length of time a person lives, etc. The blood may collect in circumscribed masses or become infiltrated in the surrounding tissues, although usually both phenomena are observed. The extent to which infiltration takes place depends upon the quantity of blood and the nature of the surrounding tissues. In loose tissues like those about the orbit infiltration is much more rapid and extensive.

Examination of the Weapon.—French medical jurists have tried to indicate how we may determine the time elapsed between the death of a person and the discharge of a weapon found near the body, but exact statements in this matter are utterly out of the question. Certain facts bearing on the subject are these: When recently discharged there will be found adhering to the barrel of the piece and consisting of the fouling of which sportsmen complain, a quantity of potassium sulfid mixed with charcoal. This is shown by its forming a strong alkaline solution with water, evolving an odor of hydrogen sulfid, and a dark precipitate with a solution of acetate of lead. Depending upon the degree of exposure to air and moisture, after some hours or days this sulfid becomes converted into potassium sulfate, which forms a neutral solution with water and gives a white precipitate with acetate of lead; but if a considerable time has elapsed since the discharge of the piece oxid of iron (iron rust) with traces of sulfate may be found (*Ann. d'Hygiene*, 1834, p. 458; 1837, p. 197; 1842, p. 368).

WAS THE WEAPON FIRED FROM A DISTANCE OR NEAR BY?—A gunshot injury from a bullet implies at least one wound, namely, that of entrance, and perhaps another, that of exit. It does not always happen that the bullet passes through the body. The appearance of the wound of entrance is usually one of irregular circular puncture, its edges perhaps slightly torn or lacerated, with a purplish or dark areola, varying in width from a line or two to one-half inch. When the weapon is fired close to the body there are likely to be more or less powder-marks, and possibly actual burning from the heat and flame of the gunpowder. If the part of the body injured had been covered by clothing at the time, the marks of powder and of burning would probably be confined to the same. Bleeding is usually slight and occurs more commonly from the wound of entrance than from that of exit. Regularity of either of these wounds depends in large measure upon the angle at which the bullet has struck the surface. When striking very obliquely the wound may be more oval or the bullet may have ploughed a furrow or a channel, by a study of which the relative position of the assailant and the assailed at the moment of injury may, perhaps, be determined. It is of importance to determine if possible the approximate distance at which the bullet was fired, since the question of self-defence, for instance, may hinge upon evidence of this character. The charge of powder and the weight of the bullet being known, one may sometimes estimate this distance by the depth of penetration or the appearance of the bullet. Still, the nature of the tissues must figure largely in such consideration. Many suicides who shoot themselves in the head show only one wound of entrance and none of exit.

Experiments Testing Powder-Marks. — Charges of powder are not entirely consumed in generating gases of ignition. By firing a revolver at short range at a piece of blotting-paper, many powder grains, especially of the old type, can be caught in it and ignited by themselves. It used to be estimated that less than sixty per cent of the old powder was really effective; the balance is thrown out in granular and usually unignited form, each particle acting as a tiny missile. Powder-marks on the skin consist, then, of a series of minute foreign bodies, some of which, at least, *may* be infected (see below). Powder-marks and burns from weapons ordinarily used will scarcely appear when the distance has exceeded ten or twelve feet. LaChese, of Antwerp, found that in firing a gun even from a distance of only four feet the skin was only partially blackened.

As the result of experiments made with a Ballard rifle, old style, .44 calibre, with bullets of 220 grains and 28 grains of powder, Dr. Balch, of Albany, found that powder-marks were made at distances as follows:

At two feet, particles too numerous to count, with some of the lubricant blown upon the board;

At four feet the same;

At six feet the same;

At eight feet, nine grains of powder;

At ten feet, five grains of powder in one case and six in another.

That these were powder-grains were shown in court by picking some of them out, placing them on a glass, and igniting them with a galvano-caustic point. From those at ten feet no distinct flash could be elicited; from those obtained at eight feet distinct flashes were seen (Trans. New York State Med. Soc., 1881).

In the celebrated case of Peytle, brought in 1839 for the murder of his wife, who had been killed by two bullets entering near the nose, the eyebrows, lashes, and lids were completely burned, and a large number of powder grains were imbedded in the cheeks. Experiments being made in order to ascertain the distance necessary to produce these effects, it was found that the weapon must have been held within a distance of twelve inches.

The new *Smokeless powders* produce marks upon the skin quite similar to those of the old black powders, especially a *tattooing* (see above, "Evidence from the Projectile"), whose area and dimensions will vary with the distance of the weapon. Nevertheless these marks have a distinctive appearance with each kind of powder, differing in color, incrustation, and brand. In color the marks are much lighter, both upon skin and clothing. The bichromate powders give a greenish tint, the others a more gray tint. The gun-cotton powders produce even harder grains in the skin than does the old black powder (Thoinot: Congrès Internat. de Méd.; Section de Méd. Légale, Paris, 1900, p. 157. See also Corin: "Recherches sur les moyens propres à fixer la distance à laquelle un coup de feu a été tiré," *Annales de la Société de Méd. Légale de Belgique*, IX., 1897, p. 194.)

The number of grains in a given weight varies very much with the fineness of the powder. Of the French powder made of 17 per cent of ammonium bichromate and 83 per cent gun-cotton, the rifle powder contains 300 grains to the gram, while a gram of the fine powder used in revolvers contains 2,000 grains. By studying the powder-marks on the skin it may then be possible to form a conclusion as to the kind of powder used, and consequently as to the weapon (Chatellier: "Revolver et Nouvelles Poudres," Thèse de Paris, 1897, No. 336).

Wounds of Entrance and of Exit.—A great deal has been written in time past about the peculiarities of the wounds of entrance and of exit, much of which cannot be maintained under expert criticism. It is true that the wound of entrance will usually be well defined, the skin slightly depressed and appearing as above noted. It is true also that powder-marks will appear about this wound rather than that of exit. Usually, too, the orifice of exit is larger, less regular, its edges everted slightly, with more or less laceration of the skin, and quite free from any powder-marks or evidence of burning. The depression at the border of the wound of entrance differs after some days, by which time the contused margins slough away, and its appearance is daily changed by a process of granulation providing the individual recover or live long enough. According to Dupuytren, the hole in the clothing is smaller than that made by the same bullet in the skin. These are all points worth remembering when fitting bullets into wounds which they are supposed to have made; but the conditions under which gunshot punctures occur are constantly varying, and the significance of local markings is mainly the product of experience, care, observation, and reasoning. Thus the shape of either of these wounds will depend naturally upon the integrity of the bullet and its original shape and dimensions. Matthysen's experiments give the following: A pistol fired at twelve paces distance, with a ball 15 mm. in diameter, made a wound in chest of 8½ mm. diameter, and at its point of exit at the back one of 10 mm. In two experiments at the same distance as above, the entrance wound was 4 mm. larger in diameter than that of exit, and when a larger ball with a diameter of 17 mm. was used the same results were preserved, both wounds being less in size than the ball which made them. A spherical ball will usually cause more loss of substance than a conical, while the latter will cause usually more irregularity of outline and may even give the wound of entrance a slit-like appearance. Complications may also occur from other sources; a single wound of entrance may give rise to two or more wounds of exit due to splitting of the bullet, or if the bullet have been divided and the larger part lodged in the bone, only the smaller portion passing out, the wound of exit may in reality be much smaller than that of entrance. Again, a bullet may split into fragments before striking the body, and of these one may enter the body, or one or more of them lodge. Multiple wounds are possible even from one bullet, as when it passes through two different parts of the body. Again, when two wounds, for instance, are discovered, one of them may be regarded as that of exit, when in reality they may be two wounds of entrance, neither bullet having left the body. So while it is possible in some cases to decide which is which, too much dependence should not be placed upon appearances of this kind, least of all until after a careful autopsy has been made.

Course of the Projectile.—When a bullet traverses a body the two apertures may be nearly opposite to each other, although the bullet may not have taken a direct course between them, having been deflected by tissues of varying density in its course. This leads to the mention of the effect of animal tissues upon the course of bullets, with which works on military surgery deal extensively.

The following is a remarkable illustration, yet authentic, of a devious path of a ball. In a duel with pistols between two students at Strasburg one fell, apparently mortally wounded in the neck, but recovered without feeling any inconvenience from his wound. It was found that the bullet had struck the larynx and had gone completely around the neck. It was taken out by simply making an incision over it. Other instances may be cited where bullets have made a circuit around the head, thorax, or abdomen. The ball may make a half circuit of the body and lodge or emerge at a point opposite that at which it entered, thus leading one to suppose that it must have passed directly through (Wharton and Stille).

As the writer of a chapter on the effect of projectiles of small-arms, in the Third Surgical Volume of the "Medical and Surgical History of the War of the Rebellion," p. 709, says: "Such bullets attain great range and effectiveness as oppose least frontage of resistance to air; their velocity consequently is greater. Rotation upon their long axes tends to give them steadier flight and more direct course. By their pointed apices they pierce more easily the structures opposed to them. Such bullets, owing to the elasticity of the skin, make a wound of entrance perhaps a trifle smaller in diameter than themselves, while spherical balls are more likely to carry a portion of the integument in with them."

The differences of structure and density of the muscle tissues and their aponeuroses encountered by a bullet in its passage materially influence the directness of its course unless its velocity be very great, while round bullets are the more easily deflected from their course. The track of a small conical bullet passing swiftly through a muscle is more cleanly cut than that made by a round bullet, but in all gunshot wounds there is usually found a regular canal, with lacerated walls, with more or less destruction along the area of injury, shading off concentrically until lost in healthy tissue. There is always loss of substance dependent on muscle tension or direction of the bullet, whether transverse or obliquely to the direction of the muscle fibres; the more fibrous structures are torn and lacerated or simply perforated, mainly owing to their different tension at the instant; their openings seldom correspond to those of the muscle tissues or those upon the surface of the body, because of the constant change in the relation of the parts due to muscle action. This makes it often difficult to follow the course of a bullet with accuracy. The irregularity of a bullet-track due to these causes constitutes one of the great sources of danger, since cavities and pouches thus formed give lodgment to foreign matter driven in with the bullet, by retention of which a fertile source of sepsis is maintained. Gunshot injuries of bone may be classified as contusions, simple fractures, partial fractures, penetrations, perforations, and complete fractures with more or less comminution or loss of substance, all of these, of course, in the surgical sense compound. These are all manifestations of mechanical force acting in accordance with established laws. On autopsy these will be ascertained, while one or more portions or all of a bullet may be found imbedded in or attached to some bone. The best illustration of such accidents will be found in the "Medical and Surgical History of the War of the Rebellion."

Such questions as pertain to the position of the wounded person when shot or that of his antagonist, and other similar inquiries, can only be settled by reference to particular circumstances of individual cases. Position of the wound may help a little. A bullet-wound directly in the centre of the top of the head could scarcely be received by a person standing unless his assailant occupied an elevated position. If accompanied by evidence of severe blows by which the deceased might have been knocked down, it might show that he had been shot after falling.

Wounds by Small Shot.—Small shot rarely traverse the entire body unless discharged from such proximity as to make a clean, round opening. Paley relates the following instance: A boy was shot in the neck by the accidental explosion of his own gun, No. 8 shot. He died instantly. He was lying forward of the muzzle so that it was nearly in contact with the skin of the neck. A large round hole was produced, in diameter one and one-half inches, whose edges were slightly darkened by powder. The wound of exit at the back of the neck, at the third vertebra, was a mere slit in the skin scarcely an inch in length with the diameter placed vertically. The smallness of this aperture may have been owing to the greater part of the charge being lodged in the body. Dr. Lowe states that in some experiments it was found that a round aperture might be produced by a discharge of small shot at a much greater distance than that assigned by Dr. LaChese, namely, ten to twelve inches. Even admitting such exceptional instances, it will scarcely ever occur that a wound from a small shot can be mistaken for one produced by a leaden bullet.

De Vergie has shown that when the ball enters a portion of the body well covered with fat, this often protrudes between the edges of the wound and may alter its character. If clothing have been carried in some shreds of it may show upon the wound, and such fragments of texture will nearly always characterize the wound at once as that of entrance.

"Accidental" Gunshot Wounds.—Hall has summarized and illustrated circumstances under which these occur, with special reference to cases where homicide was made to simulate accident (*Medical Record*, Sept. 19th, 1896).

Wounds by Blank Charges.—Experience has shown that no matter with what the piece is charged, it is capable, when fired close by, of producing a wound which may prove fatal. Thus a gun loaded with wadding or gunpowder only may cause death. A portion of clothing may be carried into the wound and lead to death from hemorrhage, or death may occur from many secondary causes, such as tetanus or sepsis. Accidents so frequently occur from weapons discharged in sport, not loaded with ball or shot, that it is worth while to bear this in mind. It has been observed, for instance, that persons attempting to commit suicide have forgotten to put a bullet in the pistol, nevertheless the discharge of the weapon into the mouth has sufficed, from the wadding alone, to produce a considerable laceration and hemorrhage (Taylor). Many fatal accidents have taken place by the discharge of wadding from cannon. LaChese has ascertained by experiment that a piece charged with gunpowder alone is capable of producing a penetrating wound somewhat resembling that produced by gun-shot, when the piece is large and fired within six feet of the body (*Ann. d'Hygiene*, 1836, p. 368). This arises from unexploded grains of powder acting as pellets of small shot. Sweet has experimented with pistols loaded with gunpowder and wadding in order to determine the effect of their discharge at different distances. At twelve inches he found that the clothing was lacerated and the skin abraded, but the wadding did not penetrate; at six inches the clothes were lacerated and the wadding penetrated to the depth of one-half inch; at one and one-half inches from the chest the wadding passed into the thoracic cavity between the ribs, and at a second experiment carried away a portion of the ribs.

It is probable that an ordinary wadding such as loosely wrapped paper, rag, or similar material, especially as prepared by one not accustomed to military use of a weapon, would not produce a wound which would resemble that made by a bullet, and it is doubtful whether such a wound could be produced at a greater distance than six inches from the body.

It is on record that in Paris, in 1858, a circus cannon of four inches bore, loaded with three ounces of grain powder retained by a wad of old theatre bills loosely folded together and rammed home with only moderate force, was discharged in the direction of the boxes at a distance of about one hundred and fifty feet. A man seated in one of these boxes opposite the muzzle of the gun, leaning forward, his arms crossed upon the handle of his umbrella, had his arm broken above the elbow immediately upon its discharge. Several portions of wadding were found beneath the place where the man sat, but no marks existed upon his clothing nor upon the anterior part of the arm, which must have been inaccessible to any projectile that did not first strike the forearm. It was concluded that the fracture had been caused by the violent and sudden starting of the man backward, which must have brought his arm against the hard part of the partition. An experiment tried with the cannon proved that any wadding that could be made with paper was dispersed in passing, or lost all power of mischief, at much less distance than one hundred and twenty feet (*Annales d'Hygiene*, 1859, p. 420, Wharton and Stille).

IDENTITY FROM A FLASH OF GUNPOWDER.

Taylor states the following: "Among the singular questions which have arisen out of this subject is the following: whether the person who fires a gun or pistol during a dark night can be identified by means of the light produced during the discharge. This question was first negatively answered by a class in physical science in France, whereas later a case tending to show that their decision was erroneous was subsequently reported by

Fodere. A woman positively swore that she saw the face of the prisoner, who fired at another during the night, surrounded by a kind of glory, and that she was thereby enabled to identify him. This statement was confirmed by the deposition of the wounded party. Desgranges, of Lyons, performed many experiments on this subject, and he concluded that away from every source of light the prisoner who fired the gun might be identified within a moderate distance; if the flash were very strong, the smoke very dense, and the distance great, the person firing the piece could not be identified. The question was raised in England in the case of Reg. *v.* White at the Croydon Autumn Assizes, 1839. A gentleman was shot at while driving home on a dark night, being wounded in the leg. When he saw the flash of the gun he saw that the piece was levelled toward him, and the light of the flash enabled him to recognize at once the features of the accused. In cross-examination he said he was quite sure he could see the prisoner and was not mistaken as to his identity; but the accused was skilfully defended and he was acquitted. A similar case was tried at the Lewes Lent Assizes, 1862, Reg. *v.* Stapley. The prisoner shot at the prosecutor on a dark December evening, and the latter swore that he distinctly saw the prisoner by the flash of the gun and could identify him by the light on his features. His evidence was corroborated and the man was convicted. A case is also quoted, Rex *v.* Haines, in which some police officials were shot at by a highwayman during a dark night. One of these stated that he could distinctly see from the flash of the pistol that the robber rode a dark-brown horse of remarkable shape, and that he had since identified the horse at a stable in London. He also was positive that the prisoner had on a rough brown great-coat.

There seems to be enough evidence in this direction to show that identification under these circumstances was occasionally possible, but now that smokeless powder is in such general use this will be nearly if not quite impossible.

GENERAL MEDICO-LEGAL CONSIDERATIONS.

The result of the wonderful advance in the practice of surgery made during the past fifteen years has been in a large measure to revolutionize the treatment of gunshot wounds, and inasmuch as the result of many homicidal attempts will depend in large measure upon what the surgeon can do for the victim of assault, it may not be amiss to very briefly epitomize in this place something of what modern surgeons believe with regard to the best treatment of bullet-wounds, expressed in a general way. They have learned, among other things, that the harm which a bullet does is done by it during its flight, and that after it has come to a stop it is, *per se*, an almost invariably harmless foreign body. This is practically always the case unless it has carried in with it foreign material which may serve as a source of septic infection.

In time past there has always been a strong feeling, which had, however, nothing scientific to justify it, that every gunshot wound was a poisoned one. Of late, since bacteriology has attained the proportion of a science, it has been held that bullets were necessarily sterilized by the heat of the discharge of powder behind them. Very recently Dr. B. Von Beck, Medical Director of the 14th German Army Corps, has made experiments upon the amount of heat imparted to leaden and other bullets after firing. After making an allowance for specific heat and the conductivity of the different metals used, he found that even when the projectiles encountered resistance from three to four times greater than that offered by the human body the results were as follows: Temperature of leaden bullets of .45 calibre, when recovered, 69° C.; of .30 calibre, covered with steel, when recovered, 78° C.; of .30 calibre, covered with copper, when recovered, 101° C. He states that these experiments disprove the theory that certain lesions in wounds can be in any way attributed to the heat imparted by the bullet.

While these experiments prove that the bullets may be heated to the above degrees when recovered, they by no means prove that they are so heated at the time when they inflicted the wound. During the year 1892 some very interesting experiments were carried on by Dr. Lagarde, of the Army Medical Department (*New York Medical Journal*, Oct. 22d, 1892, p. 458). He experimented by deliberately infecting bullets and then firing them into cotton, and animals as well, studying the effect both on the bullets themselves and upon the animals. Some of these bullets were taken from the original packages, while others had been intentionally rolled in dirt. The experiments were carefully carried out and appear reliable, and the conclusions given by the author, which interest us here, are as follows:

(1) The vast majority of cartridges in original packages are sterile or free from septic germs because of the disinfection and absolute cleanliness observed in the process of their manufacture.

(2) The majority of gunshot wounds are aseptic because the vast majority of the projectiles inflicting them are either sterile or free from septic germs.

(3) The heat developed by the act of firing is not sufficient to destroy all the organic matter of the projectile, the cherished notions of three centuries or more to the contrary notwithstanding.

Tavel has found that infected bullets cause severe suppuration in animals. He insists that in medico-legal matters we must not take a too purely mechanical view of gunshot wounds (*Gazette hebdom. de Méd.*, April 28th, 1898).

La Garde also fired a bullet infected with tetanus into a horse without result. More than this, he placed a bag of tetanus earth against the hip of another horse, and then sent a small Springfield bullet through this into the flesh, and again without result (Trans. Pan-Am. Med. Cong., I., 699, 1893).

Not only the bullet but the powder *may* be the source of an infection. Nimier, a French Army surgeon, has reported four cases of tetanus after powder-burn from blank cartridges. The injuries happened during sham battles, and though first-aid was prompt, infection resulted. The powder was the old-fashioned black powder. La Garde has shown that the recent smokeless powder is much less likely to carry infection in this way, but that it may happen (*N. Y. Medical Record*, June 22d, 1895, p. 784).

The results as set forth justify the assumption that a septic bullet *can* infect a gunshot wound. The average bullet-wound, however, is sterile so far as infection from the bullet is concerned, and in accordance with this view of its usual innocence there need be no longer the clamor for removal of the missile which the fears of previous generations have nearly always called for; and the best practice among *military surgeons* of to-day is rather to let the bullet remain where lodged than to make a more serious wound for its removal. Exceptions to this rule occur only in cases where operation is called for on account of injury done by the bullet while still in motion. It is also held to be a violation of simple physiological and surgical rules to probe or carelessly search for a bullet whose location cannot be made out from a study of signs and symptoms in a given case. The act of probing breaks up blood-clot, often brings on fresh hemorrhage, is in a majority of cases unsatisfactory, frequently introduces specific elements from without, and really gives little, if any, more information than can be gathered from a study of the case without the use of the probe. If every ordinary bullet-wound which did not call for immediate operation because of injury to some essential or vital part —such as a large blood-vessel or nerve-trunk, or some of the viscera—were antiseptically and hermetically sealed at the very outset, there would be a much smaller percentage of death from gunshot wounds, either in civil or military practice, than now obtains. And it might be a matter upon which to go to the jury whether violation of such rules, to-day, does not mitigate the offence of the accused.

Recent discoveries in so-called cerebral localization have instigated numerous operations upon the skull and brain for the relief of pressure, as from blood-clot, or for removal of depressed bone or a bullet which twenty years ago would have been impossible. The brain is no longer the *terra incognita* of the past generation of medical men, and it is now often possible for the surgeon to intervene in such a way as to save life in cases previously considered hopeless; in fact, such is now his duty when consent can be gained, and it should be held that he is culpable when deficient in general knowledge in this respect.

In wounds of the thoracic cavity it should now be held that so long as air has entered through a bullet-wound there are cases where free incision, even with removal of ribs, can scarcely increase the dangers, while permitting opportunity for much more accurate exploration and determination of life-saving methods. The experiments of numerous investigators, the writer included, have shown that bullet-wounds of the heart need not be always and invariably fatal, and have afforded an element of hope from the possible surgery of even this organ.

The writer looks forward to the time when some accomplished yet daring surgeon, getting the right patient at the right time and in the right place, *i.e.*, where conveniences are at hand, shall, in some case of perforating wound of the pericardium or of the heart itself, resect some portion of the anterior thoracic wall, lay open the pericardium, maintaining meanwhile artificial respiration if necessary, and suture a wound in the heart-substance, thereafter closing the pericardium and external wound, and save life which would otherwise be surely sacrificed. With others he has done this upon animals, hence why may it not be done in man?

In the mean time for, first, the recognition and, second, the surgical treatment of perforating wounds of the abdominal viscera, American surgeons have won for themselves the greatest credit, and an already long list of successful laparotomies after gunshot wounds of the intestines, with intestinal suture or resection, has shown the very great value of this procedure, even though it has kept some would-be murderers from the gallows.

These lines are inserted here because the time and effort which surgeons have devoted to this kind of surgery deserve only the highest encomiums and encouragement from the legal profession, although to our deep regret they have not always met with the same.

INTRODUCTION OF RONTGEN PHOTOGRAPHS AS EVIDENCE.

Skiagrams were first introduced in court at Nottingham, England, in February, 1896. The courts have seldom excluded this kind of evidence, and it is now generally admitted. Once, in New Jersey, the court, finding that no precedent existed in that State (as if there could have been), declined to establish one (*Medical News*, Oct., 1897). Without commenting on the possible fallacies of such evidence it must be held to be of great importance in certain instances. The recent government publication by Borden will afford abundant illustration of its possibilities.

Röntgen rays have also been used in examination of packages supposed to contain infernal machines (*Ann. d'Hyg. pub.*, Mai and Août, 1896).

OF THE VARIOUS CONDITIONS WHICH COMPLICATE GUNSHOT WOUNDS AND MAKE THEIR RESULTS UNCERTAIN,

Delirium Tremens is one of the commonest and must always be regarded as one of the most serious. It is well known to surgeons that a slight injury even, and often a severe one, is enough to provoke manifestations of this character in intemperate persons. The medico-legal question under these circumstances is this: Would the same amount of injury have been likely to cause death in a person of ordinary health and vigor? The law as applied to these cases has been stated by Lord Hale: "It is sufficient to prove that the death of a person was accelerated by the malicious acts of the person, although the former labored under a mental disease at the time of the act. The intent of the accused may often be judged by the character of the wound and the means of its infliction. Drunkenness of the victim admits of no excuse when his assailant is aware, or ought to have been aware, of the condition of his victim. It is held that the assailant ought to have known that violence of any kind to such a person is likely to be attended by dangerous results. It is known also that a wound which accelerates death causes death." The commissioners who were appointed to define criminal law on the subject of homicide have thus expressed themselves: "Art. 3. It is homicide although the effect of the injury be merely to accelerate the death of one laboring under some previous injury or infirmity, for although if timely remedies or skilful treatment had been applied, death might have been prevented" (Taylor, p. 327).

Death from Surgical Operations Necessitated by Gunshot Wound.—The modern treatment of serious or so-called penetrating gunshot wounds where the cranium, thoracic viscera, or the abdominal viscera, especially the intestines, have been perforated one or more times, calls for surgical procedures which are of severity and danger in proportion to the gravity of the wound which necessitates them, and which, while they often save life, must necessarily often fail. Indeed, such operations may prove fatal upon the operating-table, *i.e.*, patients may die before the conclusion of the operation. The question may, therefore, arise whether the person who inflicted the wound should be held responsible for his act, or whether by the intervention of the surgeon the responsibility may not at least be shifted from the shoulders of the accused. The law in this respect is explicit and regards such operation as the outcome of necessity and a legitimate part of treatment, so that if it be undertaken in good faith, with reasonable care and skill, the accused will be held responsible, be the result what it may. The question of necessity and the plan of operation are left to the judgment of the surgeon in charge. Considering the responsibility involved in such cases and the possibility of a suit being raised, we should always advise the operator to secure the counsel of other surgeons or practitioners in his vicinity. The verdict of such a counsel of talent will always stand. According to Lord Hale, when death takes place from an unskilful operation under such circumstances, and not from the wound, the responsibility of the prisoner naturally ceases, but the burden of proof that such has been unskilfully performed rests naturally with the defence. It is much better also in these cases that the primary responsibility be borne by one surgeon from the beginning of the case, though he may associate with himself as many others as he chooses, since the ends of justice have more than once been defeated by a division of such responsibilities. Should it be made to appear that the surgeon in charge has not availed himself of such means as are supposed to be in the hands of every competent practitioner and has neglected ordinary antiseptic precautions, it would not be difficult to show that the operation had been unskilfully performed, and the prisoner would naturally get the benefit of such defence. At the present date of writing there exists a large class of the profession who still continue to do surgery according to the views and practices of twenty or thirty years ago, and who, while perhaps carrying out some of the forms of antiseptic surgery, are still ignorant of its fundamental principles and consequently guilty of neglect, since there is now no reason why all should not practise them. The writer holds to the view that if it can be shown that these precautions were not adopted when others would have adopted them, it constitutes criminal neglect.

On the other hand, circumstances may arise where a simple or a more serious operation would have saved life, as, for instance, in cases of hemorrhage, and where a surgeon from timidity or carelessness has failed to take the necessary steps. Such neglect as this should inure to the benefit of the accused, but when at any time it can be shown that the possible benefits of operation have been offered to the deceased before his death and have been declined, the surgeon at least is relieved of all further responsibility. Among the dangers of operations under these circumstances are of course to be reckoned those pertaining to the use of anæsthetics. The surgeon in charge, however, is responsible for the selection of his assistants, at least when assistants are at hand, and must be regarded as equally competent in this as in other features of the operation; and even though the patient die from collapse or the anæsthetic, the burden of proof must rest with the defence to show that it had been unskilfully administered.

NOTE.—The assistance which the microscope may afford in the procurement of evidence in cases of gunshot wound is beautifully illustrated in the expert testimony reported by Dr. James, of St. Louis, in the presidential address before the American Society of Microscopists, in Washington, August, 1891, printed in Vol. XIII. of its Transactions. It occurred in St. Louis, in the case of The People *v.* Vail, who had a pistol in his pocket at the instant when his wife fell from a wagon against him, knocking him, as he claimed, against the wheel of the wagon, the pistol being discharged by accident. By a minute study of the fibres of the various textures making up his overcoat and of the effect of the explosion of powder upon textile fabrics almost in contact with it, he was enabled to establish the accident and secure the acquittal of the accused.

THE MEDICO-LEGAL RELATIONS

OF

ELECTRICITY.

BY

WILLIAM N. BULLARD, M.D.

MEDICO-LEGAL RELATIONS OF ELECTRICITY.

As the frequency of accidents caused by electricity is rapidly increasing, we have of late years been enabled to generalize in a manner never before possible in regard to their results, and although our present conclusions must be recognized as provisional and perhaps temporary—to be changed or modified in accordance with future knowledge—yet we have obtained a basis of fact on which we can securely rely. The general laws of injury and accident through electricity have been fairly well determined, although many of the details are not yet thoroughly worked out or understood. The advances of knowledge in this direction are so rapid that an article on this subject, if it deals too closely with details, is liable to become out of date almost before it has left the press. Like all large subjects when first made objects of general interest and investigation, and in regard to which we are on the threshold only of knowledge, the facts discoverable may lead us at any time in unexpected directions and open out new fields of thought and inquiry. We shall try to limit ourselves here, as far as possible, to proved facts, and leave questions doubtful or in dispute to be settled later; contenting ourselves merely with pointing them out and, perhaps, in some cases giving the facts on either side.

Electrical accidents and injuries may be divided into those which are caused by the atmospheric electricity—lightning proper, globes of fire, St. Elmo's fire—and those produced through the agency of mechanical or artificial electricity—electrical machines, batteries, dynamos, etc. The effects caused by these different agents probably vary only in degree: the atmospheric electricity in the form of lightning, etc., being so much more powerful than the charges usually produced artificially as to cause some difference in the results.

RESULTS OF ACCIDENTS AND INJURIES FROM ELECTRICAL MACHINES AND CONDUCTORS.

Medical Electricity.—In the ordinary use of the mild forms of electricity employed for medical purposes, certain phenomena may at times occur, which, although not of any serious import or of long duration, may yet cause considerable inconvenience, pain, or discomfort to the patient or others, and may even be of some importance from a medico-legal point of view. We shall not enter here into the discussion of the proper methods of application of medical electricity, nor do more than point out that if these be not followed with care the patient may be not only not benefited, but made worse, and may even suffer considerable injury. The increase of pain caused by the improper application of certain currents is usually temporary and of minor consequence. But serious and lasting inflammations may be caused by the careless, ignorant, or injudicious use of the stronger currents internally, and metritis and peri-uterine inflammations have been not infrequently reported from the unskilled practice of the methods of Apostoli. These subjects, however, scarcely come under the scope of this article.

In addition, however, to these troubles we may have *external* injuries produced. Even in cases where the current amounts to not more than a few milliamperes burns may be caused by the ordinary electrodes of the galvanic battery. The faradic current when medically used does not, as a rule, produce any external injuries. Such might be caused by a spark from a static machine, but it would be due to gross carelessness, and is very unusual. Burns, however, from the use of the galvanic current are not very uncommon. They usually occur under the electrode after it has been for a few moments stationary in contact with the skin. They occur in certain patients with extraordinary readiness, especially in those with organic spinal lesions, and where the sensation is somewhat diminished, and where also some trophic lesion might be supposed to exist. They are not confined, however, to this class of cases, but may occur in any one if the electrode be retained too long in any one place, and especially if it be allowed to become dry. These burns are peculiar in appearance and can usually be recognized at once. They are circular, as if punched out, about the size of a common pencil or a little smaller, comparatively deep, gray with perhaps a dark ring at the circumference, and frequently surrounded by a reddened area. The edges are sharp. Their peculiarity consists (1) in their painlessness and (2) in their size, regular form, their depth in comparison to their extent, and the sharp limitation of the area of tissue destroyed. One or more may occur under a broad electrode, and they are probably produced at those points where the contact is imperfect or the conduction in some other way impeded. They heal without much difficulty and leave no serious results.

Other unpleasant symptoms produced by currents in medical use may be mentioned for the sake of completeness, and also as an introduction to the more serious symptoms caused by stronger currents. Dizziness, vertigo, tinnitus, nausea, vomiting, and syncope are readily caused by even slight currents. The sensation of light in the eyes and the metallic taste in the mouth are the results of medical currents of ordinary strength when applied to the head or in its neighborhood, and stronger currents applied at greater distances cause these sensations. All the above symptoms may be readily caused by even slight currents, whether galvanic or faradic, passed through the head. The syncope thus produced is to be carefully differentiated from the syncope caused psychically by excitement or fear of the application of electricity. Hysterical women, and even persons who show no special signs of nervous instability, may faint at the suggestion of the application of electricity. I have seen a large, strong, well-built Italian man, perfectly sound physically, so far as could be detected, except some slight local neuralgia, faint from pure fright when the electricity was to be applied. But even the application of moderately severe shocks from the ordinary medical battery are not likely to produce serious results. These shocks are ordinarily caused by the opening or closing of the galvanic current, and are most severe when the current passes through some portion of the head. A still more powerful shock may be given by reversing the current in a galvanic battery by means of the commutator.

CURRENTS OF HIGH TENSION—STRONG ARTIFICIAL CURRENTS.

Passing on now to the consideration of the stronger currents, we come to those used for mechanical purposes, for electric lighting, electric railways, and other analogous objects. These currents start from dynamos or from storage batteries, and accidents are caused by them whenever they are diverted from their proper course and are caused to come in contact with or to pass through any portion of the human body in any considerable strength. Accidents not infrequently occur from direct contact with the batteries or dynamos, but still more frequently they are produced in their circuit along the wires or transmitters. They may also be caused, as some of the most fatal have been, by contact with metallic or other readily conducting objects which have themselves accidentally come in contact with some portion of an electric circuit (usually wires) and have diverted the whole, or more usually a portion, of the current to themselves. Thus was killed a young man in New York, the clerk in a store, who while lifting the metal-edged cover of a show-case brought it in contact with the charged wires of an electric light and received an immediately fatal shock. As a rule, those meeting with accidents from dynamos or electric machines directly are employees of electric companies, who are presumed to have more or less knowledge of the risk of carelessness, or they may be workers in institutions or factories in which such machines are in use. Many of the accidents due to wires also occur to linemen and other employees of electric, telephone, or telegraph companies or of electric railway companies in charge of wires or electric outfit. So long as the current transmitters and terminals (wires, etc.) are properly insulated and in their proper position in relation to other conductors, it is unusual for accidents to occur, except in cases of gross ignorance or carelessness. Unfortunately, however, proper insulation is not always accomplished, and frequently wires and other transmitters are removed from their proper positions by accidents and otherwise. So long as and wherever the system of overhead wires exists, if there be among these wires any which are the transmitters of strong electric currents, there is always a risk, and often a very serious one, that at some time or other one of these current-bearing wires will come into contact with some other non-current-bearing and ordinarily harmless wire in such a manner that the current of the first should be diverted, in whole or in part, on to the ordinarily innocuous wire, which thereby becomes at once charged and dangerous. Such an accident may be due to the displacement of either wire or to any other cause which brings the two in contact, either direct or indirect, at a point where the current-bearing wire is not sufficiently insulated. The current having once passed out of its proper circuit will, of course, follow the paths of best conduction, and may hence suddenly appear in unexpected quarters and produce the most dangerous and even fatal effects. It is accidents of this character which most frequently occur among the people who are neither employees of electric companies nor engaged in factories or buildings where electrical machines are employed.

Insulation of Wires and Other Electrical Transmitters.—We cannot mention here the various methods employed to insulate wires, as the general principles of insulation are well known. Electric wires even with very strong currents can be insulated and can be kept insulated if sufficient pains be taken and sufficient money be expended. But this is very expensive and in many cases is not done. Only partial insulation is attempted, and even this is not always carried to the degree intended or stipulated. Hence so long as overhead wires of various kinds exist, accidents from the transmission of strong electric currents along ordinarily harmless wires are liable at any time to occur, as practically little or no attempt at keeping the current-bearing wires covered with a thoroughly insulating material is in most cases made. It is usually deemed sufficient that glass or other insulators should be so placed that under ordinary conditions the wire will not come into contact with any conductor which may cause any essential part of its current to diverge. In most cases a so-called insulating material is placed over the wire itself, but this usually is insufficient at the outset or becomes so before very long and is then not renewed.

It must not be supposed, however, that underground electric wires or transmitters cannot produce accidents. On the contrary, the current may be diverted from them to the gas or water pipes or to any other conductors which come into contact with them or can attract to themselves a portion of their current. Severe shocks have been experienced by persons attempting to draw water at their faucet from causes of this character. At the same time, so far as mere safety is concerned and freedom from electrical accidents, it would seem that underground wires are preferable to overhead wires.

Electrical wires have not infrequently come in contact with telegraph and telephone wires causing unpleasant results. Telephone boxes have been set on fire, and also telegraph boards and tables, and in certain cases what might have been serious conflagrations have been started in this manner. By means of proper arrangements on the telegraph and telepbone circuits these dangers can be at least partially avoided, but there is always the risk that the automatic alarms and other contrivances do not act, and the still greater one that persons or things may come into contact with these charged wires and receive dangerous or serious injuries.

Electric Cars.—The danger from the overhead wires in the trolley system of electric cars would not be great were these wires properly supported, properly insulated, and properly protected. Each of these terms must be explained. Wires which fall for any cause whatever short of being intentionally removed cannot be deemed properly supported in the sense in which we use the term. Any one of these electric wires which falls is liable to produce serious injury to persons or animals (many horses have been killed by them), or to set fire to objects with which it comes into immediate or indirect contact, the amount of injury being in part dependent upon the nature and the condition (wet or dry) of the object and its position in relation to other conductors. Wires as dangerous as these car wires should be so supported that no ordinary accident, no condition of the weather, strong winds, or heavy falls of snow should be capable of wrenching them from their supports, and they should be placed in such positions and with such protection as not to receive blows from passing or falling objects.

Secondly, these wires should be properly insulated. This is to be understood to mean that all the wires which carry the electric current, or are liable to carry it, should be attached to their poles or other support in such a manner that no appreciable quantity of electricity is under any circumstances liable to be diverted to the poles or supports, and in this way cause destruction or injury. In addition to this the side wires should be so covered that if any accident occurs, it will be difficult or impossible for the current to pass away from them to other objects. The middle wire on which the trolley runs cannot be thus covered, but must be left bare, and hence, if knocked down or brought into contact with properly conducting objects, must be the most dangerous; but on the other hand from its position it is less liable to accidents.

When we say that these wires should be properly protected we mean that such arrangements and contrivances should be used as will prevent them while in their usual position from coming into contact with dangerous objects, particularly with other wires. This may be accomplished by guard wires or in other ways. It is plainly of great importance that this should be specially cared for, and particularly in a city where there are many overhead wires, and perhaps a considerable number of dead or non-used wires. If the electricity comes into contact with one of these no one can tell where it may be transmitted or what harm it may do.

The principles which apply to these overhead wires of course apply *ceteris paribus* to all other electric overhead wires, and in like manner the statements made in regard to the diffusion or spreading of currents in underground wires are applicable to all methods of transmitting electricity mechanically through the ground so far as the conditions are similar. An electric current will always follow the path of best conduction, and where several paths are opened it will follow them proportionally according to the excellence of their conduction or inversely to the amount of their electric resistance.

We shall not enter here into any questions in regard to the diffusion of electricity, its transmission through fluids, water, air or other gases, nor shall we discuss the relations of good or bad conductors to electricity except so far as this relates to certain portions of the human body. An elementary knowledge of physics and electricity must be presupposed.

We can now enter more directly upon the immediate subject of this article, that is, the effect upon the human body of severe or moderately strong currents of electricity derived from artificial sources. The accidents produced by these currents may be divided into two classes, the direct and the indirect. Under the direct we place all those conditions which are apparently produced by the action of the electricity itself, such as the general shock, the loss of consciousness, the burns, etc. On the other hand, all those accidents are to be considered indirect which are not primarily due to the action of the electric current, but are only secondary results thereof. These are largely determined by the immediate surroundings and conditions at the time. Such, for example, are the surgical injuries due to falls caused by the loss of consciousness produced by the electric shock.

INDIRECT ACCIDENTS.

These will be considered first, as they do not demand so detailed a description as the direct. They are traumatic in character and are the result either of loss of consciousness, momentary or lasting, or of the involuntary muscular contraction which may be occasioned by the electric shock. They are among the most frequent effects of severe electric shocks. These accidents consist in contusions, fractures, dislocations, wounds, and any other injuries which may be produced from sudden loss of consciousness while in a dangerous position. Death may readily occur either immediately or as the more or less delayed result of such injuries. If the person shocked falls into the water he may be drowned, or if into the fire he will be burnt. The varieties of such accidents dependent on the sudden loss of consciousness produced by the electricity are, of course, innumerable, and their occurrence must largely depend upon the position of the victim at the moment of the shock. We see, perhaps, most of these accidents in linemen on the tops of poles or houses or in other exposed places, but persons who receive shocks when simply standing on the ground or when sitting are not exempt from severe surgical injuries other than burns. They are often cast to the ground with great violence, and not infrequently are thrown to a distance of several feet. This is caused by the violent muscular contraction produced by the electric shock, and it may occasion, like any violent push or fall, severe injuries from contact with the various objects against which they may be forced. Although much rarer, it is also possible that the violence of these muscular contractions may be such as of themselves to cause injury, as rupture of a muscle or tendon. As practically all these indirect accidents are traumatic and surgical in character, they do not differ from other accidents similar in kind, but otherwise caused, and are to be treated on the same general principles as these.

DIRECT ACCIDENTS.

Quite different from the indirect are the direct accidents; those produced by the immediate (direct) action of the electricity. These are of various kinds, which we shall consider separately. They may be divided into immediate and late symptoms, and they vary much according to the severity of the shock and the constitution of the patient, and the part of the body through which the electricity passes. The character of the current which gives the shock, whether constant or interrupted, also naturally has an influence on the effect.

General Principles.—A shock may be given in three ways with an ordinary galvanic battery. If the current be sufficiently strong, a distinct shock will be produced when the circuit is closed and again when the circuit is opened, while with a current of the usual strength for medical purposes, the sensation while the current is passing through the body steadily is much less and is often limited to a sensation of burning at the seat of the electrode. A shock may also (thirdly) be produced by a reversal of the current, and the shock thus caused is stronger for the same current than that produced in either of the other ways.

The strength of these shocks is shown both by the sensation produced and by the amount of muscular contraction caused. When now a shock is caused by a continuous or constant current which starts from an ordinary dynamo or other electric generator or storer, it is practically always caused by the opening or closing of the circuit, or, what is essentially the same, the diversion of a part or the whole of the current from its proper path to and through some portion of the human body causes a shock at the time of the entrance of the body into the circuit and another at the time of its exit therefrom. Shocks from reversal of current when such current arises from a constant machine might occur, but only through some peculiar accident. Hence the shocks (distinguished from any other effects of electricity) which are received by the person coming into contact with a constant current are felt only at the moment of entering the circuit (closure) and of leaving it (opening). If a person introduces himself between the two wires of an electric circuit in which a constant current is used, in such a manner as to cause the current to pass through his body, he will feel the shock only at the moment when he touches the second wire and completes the circuit, and at the moment when he lets go one of the wires and opens the circuit (unless the current be so strong or be so placed that he can divert to himself sufficient electricity to cause a shock, or, in other words, close a secondary circuit in some other way). While the current is passing through the body, although it may burn and cause tingling and other unpleasant symptoms, there is no proper shock. In other words, an electric shock is caused only by a *change* in the amount of electricity passing through the body or a portion thereof.

If we now consider the effects of **alternating currents**, we find that we have another factor to deal with. The general principles are exactly the same, but inasmuch as the reversal shock is stronger than the closure or opening shocks, other things being equal, we are likely to receive a stronger shock from a current of the same force, and in addition to this, as in alternating machines the reversals occur with considerable rapidity, the person who becomes connected with this circuit receives a number of strong shocks within a short space of time. This is a much more serious matter than to permit a current of equal strength to flow through the body without change.

Faradism.—The effect of this form of electricity on the human body is first stimulating and then tetanizing to the muscles. It consists in a very rapidly interrupted current, the shocks being at times so frequent that they are not singly perceptible. There is probably also a distinct difference in the action of this current from that of the galvanic current aside from its rapid interruption. This is not, however, of so defined a character as to enable us at the present time to distinguish in man the results of severe injuries and deaths caused by this form from those caused by other strong currents. Practically this form of current is but little used, except in medical batteries and for the purposes of experimentation in laboratories.

Static electricity has, so far as we know, rarely or never caused serious injuries or death. The sparks produced in this way have sometimes caused burns, and it is conceivable that a strong electric current produced in this way might be dangerous. The symptoms could not be distinguished from those caused by other forms of electricity.

Summary.—The greatest source of danger from electric currents is the shock produced by them. In ordinary constant or continuous currents this is produced only at the moment of the opening and the closure of the circuit. In alternating currents a shock is also produced at each reversal of the machine. Static currents are rarely or never used mechanically or in the arts.

Resistance.—The resistance of the human body to electric currents has been very variously estimated.

The reasons for these variations are: (1) that the different tissues present different resistances; (2) that the resistance in the same tissue varies greatly under different circumstances.

The tissue which offers the greatest resistance and also practically the greatest variation is the skin, or, more properly speaking, the epidermis. The resistance of this is many times as great as that of the rest of the body, and when perfectly dry it is impervious to currents of great strength. Witz states that in using a Ruhmkorf coil with an estimated force of 250,000 volts in Guinea-pigs and rabbits, it is advisable to cut through the skin in order to apply the electrodes directly to the flesh, or, at least, to wet the skin thoroughly, otherwise the shock caused by the full strength of the battery (six jars charged from the coil) would not cause death. Various animals offer rates of resistance which vary somewhat apparently according to the nature of the animal, but are probably largely dependent on the conducting power of its tissues, that is, of its skin. The variations between the resistance of similar animals, according to the condition of the skin at the time of the experiment, are much greater than those which are found between animals of different species under similar conditions, or which are referable to specific susceptibility. Mr. Harold P. Brown testified in the Kemmler case (Court of Appeals, State of New York—State of New York *ex rel.* William Kemmler against Charles F. Durston, agent and warden) that he had in the course of his experiments seen a horse weighing 1,320 pounds, with a resistance of 11,000 ohms, killed by an alternating current at 700 volts.

The resistance of the different cutaneous surfaces of the human body as measured by Jolly in Siemens' units was from 400,000 down to 15,000 in the male and to 8,000 in the female (Siemens' unit is to the ohm as 1.06 to 1.00).

Tschirfew and Watteville made the resistance from 80,000 to 3,000 ohms.

Experiments made at the Edison Phonograph Factory and Edison Laboratory in July, 1889, on 259 males between the ages of eleven and fifty-one, showed a resistance, measured between the hands immersed to the wrists in a solution of caustic potash independent of polarization, averaging 986 ohms and varying from 1,970 to 550 ohms.

The resistance of 236 men employed at Messrs. Bergmann & Co.'s Electrical Works in New York appears to have averaged 1,184 ohms and to have varied from 1,870 to 610 ohms. These measurements were also taken between the hands, which were washed with soap and water and then dipped in jars containing a solution of caustic potash. The battery consisted of four chromic-acid cells each having an E. M. F. of 2 volts.

As shown in all the experiments on animals and more especially in the cases of electrocution, the continuance or duration of the current has much effect on the resistance. As the current continues the resistance diminishes. Thus in the case of McElvaine the resistance between the immersed hands was at the beginning 800 ohms and at the end of the contact of fifty seconds had decreased to 516 ohms. In this case, when the current of 1,500 volts was applied from the forehead to the leg, the resistance was practically steady at only 214 ohms. Of course the small resistance in these cases (electrocutions) depends largely on the perfect contact secured.

According to the amount of resistance offered do the effects of severe shocks of electricity differ. This is shown especially well in the action of lightning, but is also true of powerful currents produced mechanically. If the resistance of the skin be slight at the moment of entering the circuit of a strong current, the current will pass through it with comparative ease and without causing much injury; but if on the other hand the resistance is great, the current will be, as it were, momentarily retarded or stored, heat will be developed, and there will ensue a burning and charring of the tissue of a special kind. These burns occur principally at the places where the current is specially resisted, that is, at the point of entrance of the current to the body and at its point of exit. This is the cause of the frequent burns in the heel or sole of the foot in the case of those struck by lightning while standing, as the electricity passes away from the body into the ground and finds a strong resistance at the point of leaving the body. This is also the cause of the burns where the current leaves the body from any other cause, as from the contact or proximity of a metallic object. The greater the resistance so long as the current passes, other things being equal, the more severe is the burn. It is for this reason that in medical electricity we usually use wet sponges on the skin or electrodes moistened with salt and water or with other fluids which will assist in rendering the passage of the electricity through the skin more easy. Solutions of chlorid of sodium and of certain other salts do this.

The mechanical effects of currents vary thus according to the resistance encountered. They also vary according to the intensity or concentration of the current. If a current of moderate force be applied through a small metallic point, it will burn, pain, and produce active irritative symptoms, while if the same amount be applied over a large surface simultaneously, it may have little or no irritating effect. We have, therefore, three factors in determining the mechanical effect of any electric current on the body: (1) the condition of the body, that is, the amount of resistance which the current will encounter at its entrance and exit; (2) the amount and intensity of the current; and (3) the character of the current. For practical purposes of the more severe currents we have only to deal with the continuous and alternating.

SYMPTOMS.

Direct Symptoms.

The direct symptoms produced by powerful mechanical currents of electricity may be divided into three classes: I. The mechanical; II. The essential or internal; III. The mental or psychical.

These classes are fairly distinct, but they are not absolute, and certain symptoms are on the borders.

The most important mechanical symptoms produced by these currents are **burns.** These occur at all points of strong resistance externally, hence especially at the points of entrance and departure of the current. They vary from all grades, from the lightest possible, where only the fine hairs on the skin are singed, to those of extraordinary depth and severity. The characteristic burn from powerful currents is, however, well distinguished. It consists in a deep hole of various shapes with clear-cut edges surrounded by an inflamed area and containing in its cavity a mass of blackened tissue which only separates from the portions below after several days, and causes a wound which, though not very painful, heals very slowly. The severity of electric burns is often at first sight underrated, and their duration, when severe, is unexpectedly long. It occasionally happens that after a burn of this character appears nearly healed, the surrounding and, in appearance, healthy tissue breaks down, perhaps under a healthy skin, and a destructive process occurs which much retards recovery. This is evidently due to tissue destruction from a strong electric current of such a character as to produce necrobiosis without the external appearances of a burn. Thus a burn which in the beginning appears only a square inch in surface may later show itself to involve four or five square inches. These burns are, perhaps, oftenest seen on the hands, but this is only because these parts are more likely to come into contact with the current. They may occur in any portion of the body.

Eyes.—The injurious effect of electric light upon the eyes has been carefully studied by several competent observers. The symptoms produced by exposure of the eyes for a considerable period to the electric light may be slight or severe. In the slighter cases we find merely an acute conjunctivitis with a slight central scotoma which passes off within twenty-four to forty-eight hours. The symptoms are those usual in acute conjunctivitis—photophobia, lachrymation, sensation of a foreign body under the lids, discomfort in the eyes, and swelling of the lids. In the more severe cases all these symptoms are increased; the photophobia and lachrymation may be intense. There is sometimes severe pain in the supra-orbital nerve, and occasionally a tendency to somnolence. In these cases we find an intense conjunctivitis with chymosis, a central scotoma which may render the patient for the time practically blind, and on ophthalmoscopic examination a congestion of the vessels of the retina and choroid, a neuro-retinitis, and sometimes even hemorrhages into the retina. There is sometimes peripapillary œdema and infiltration around the optic nerve. The pupil of the eye in these cases is usually much contracted. There is sometimes loss of epithelium from the cornea. There is great risk of injury to the eyes in certain forms of engineering work, and where a brilliant light occurs, as in electric welding and boring. Cases have been reported in persons who have carelessly watched the electric drill. In these cases no special effect was noticed at the time, but some hours later intense pain came on with photophobia and spasm of the eyelids. In some cases (electric drill) only injection of the conjunctiva was found, but erosion of the cornea has been known to be thus induced.

Hewetson reports a case of acute delirium "almost amounting to mania" after working on electric searchlights. Darkened or colored glasses are generally used in occupations where such unusually brilliant light occurs.

In certain severe cases there is produced in addition to the eye symptoms an erythema of the face. Bresse states that this erythema can be produced on the face, arm, or hand by exposure to the voltaic arc at a distance of thirty to forty centimetres. The blush grows deeper for three or four hours, then remains stationary for a time, and ends in desquamation leaving a very durable pigmentation. The erythema is accompanied by a sensation of smarting.

The strength of the light and the length of time required to produce these effects probably vary somewhat according to the color of the light. Emrys Jones states that he is informed that either excess or defect of current gives a less injurious light than the normal current; the excess gives a more violet, the defect a more orange light. On the other hand, Charcot considered that the harmfulness of the electric light was due at any rate in considerable part to the chemical or violet rays, and Bresse found that when violet rays were added to an electric light as by aluminium it was more injurious than before to animals. What part the brilliancy of the light plays in determining the pathological results is not yet fully settled. The heat, however, does not, as a rule, seem to have much effect unless in extraordinary instances where the cornea is burned.

Muscular Contractions.—Another effect of electricity which is externally visible on the human system is muscular contraction. Slight muscular contractions are produced purposely in many cases in medical treatment therapeutically or for the sake of diagnosis. When the stimuli are sufficiently strong and follow each other with great rapidity, or when a strong continuous current is passed through the muscles, they are brought into a state of continuous contraction or tetanus, and in this condition they will remain for a long period or until the electric stimulus is removed. In cases where a severe electric shock is received as from an electric wire, the muscles which come in contact with the wire immediately contract and remain contracted while the current continues to pass through them. As a result of this we often find that when a severe electric shock has been received through the hands by means of a wire or other conductor the sufferer's hands are involuntarily closed upon the wire or conductor, and cannot be unclosed by any voluntary effort until the current is stopped. While thus holding the conductor the hands are often very severely burnt. Under these circumstances a strong force is required to remove a person from a charged wire if the current be not turned off, and it can only be done at a considerable risk unless by those expert and provided with special means.

Not only the muscles immediately in contact with the conductor, but nearly all the voluntary muscles of the body may be thus affected by a powerful current. Another effect of this involuntary muscular contraction is the forcible muscular movements produced by the shock. As previously stated, when a sufficiently strong shock occurs, the voluntary muscles of the trunk and limbs may be thrown into sudden contraction in such a manner as to throw the person violently and forcibly on to the ground, or against some object or objects in the neighborhood. In this way one may be propelled several feet, and many varieties of surgical injury may be caused. Rarely the force of the contraction is such as of itself to rupture muscles or tendons, and it might even fracture bones or dislocate joints already predisposed.

Essential or Internal Symptoms.

We pass now to what we may consider the internal or essential conditions of electric shock, leaving the mental or psychical results for examination later.

When a person receives a severe electric shock, the symptoms are usually as follows: In the first place there may be little or nothing except a burn or burns, though usually there is some sensation at the moment of the shock. This may be a simple dizziness, and is often accompanied by the sensation of a brilliant flash of light before the eyes, and sometimes by a sense of impending danger. Usually, however, there is a loss of consciousness more or less complete and more or less lasting according to the severity of the shock and the character and course of the current. In the less severe cases this gradually passes away, and in many cases the patient, although weak and feeling shaken and tired, suffers no further ill effects beyond those of the burns and mechanical injuries. The recovery of consciousness may be followed by vomiting. After the reaction from the immediate shock the patient may suffer severe *pain* throughout the entire body or in the abdomen and small of the back, as in Wade's cases, where it was intense. This pain may be accompanied by restlessness and sense of great internal heat. Moaning, incoherent cries, and delirium may occur.

Many symptoms referable to the motor nervous system are found. Sometimes there follows a general tremor which may last a few hours or for days, and occasionally a clonic rhythmical spasm of one or more extremities. Tonic and clonic convulsions may occur and paralyses are not unknown. The latter may be hemiplegic or paraplegic in character or may affect all the limbs, or probably may be monoplegic. They are usually transient, but sometimes seem to be dependent on organic lesions. Ataxia of the lower extremities has been reported in one case, but was suspected to be functional. Among the unusual symptoms we may mention hæmaturia. Cheyne-Stokes respiration after recovery of consciousness is said to have been observed (Donnellan). The loss of consciousness may, however, be accompanied or followed by a condition of collapse, in which the pale face, profuse perspiration, cold extremities, and feeble pulse all suggest the administration of stimulants and restoratives. As a rule, in the stage of unconsciousness the face is reddened and rather cyanotic. The pupils are dilated as a rule and the respiration stertorous or absent; the pulse may be full or feeble, sometimes imperceptible for a time. The unconsciousness sometimes lasts for hours, and all means of stimulation, electricity, artificial respiration, rubbing, have to be applied before the patient can be restored. In a certain number of cases the shock is immediately fatal, and in others the patients cannot be recalled from their unconsciousness.

The secondary results of the shock, aside from the injuries, may be very slight or again may be serious and lasting. They are far more apt to be of the first class, and when long or continued motor or sensory changes unconnected with injuries follow, we are justified in suspecting mental or psychical phenomena. One class of secondary results is the motor. In addition to weakness, unsteadiness and tremor of the limbs and trunk, it is not uncommon for the patient to suffer from grand rhythmical movements, at first, perhaps, of all extremities, but soon limited to the extremity or extremities which were most exposed or injured by the current. We have personally seen these movements, and feel convinced that they can be distinguished from most of the ordinary forms of convulsive motions and tremors. The whole limb is moved at once and not separate muscles, and the movement is a large, rhythmical one, slow and co-ordinated, not at all suggestive of tremor. Movements of this character are sometimes seen in so-called functional disease (hysteria and allied conditions). They more nearly resemble the movements seen in some forms of Jacksonian epilepsy than any others known to me as occurring in organic disease, but I believe them in these cases to be always strongly suggestive, if not absolutely significant, of functional affections. A case reported by Dr. Robert, of El Paso, well illustrates this condition. The patient, a male, twenty-eight years old, received a shock through a telephone wire. When seen first, reaction was slowly taking place, the entire muscular system was in clonic convulsions. Temperature 97°; pulse rapid and of low tension; respiration 50; no cerebral symptoms. An hour later the movements were limited to the left upper and the right lower extremities, and there was pain running from the region of the spine down the left arm. Twenty-four hours after the shock, temperature 99.5°; respiration 40; pulse 100. Had slept well, but the movements in the left arm had never ceased. The next day these motions were limited to the muscles of the forearm, and on the fourth day they had wholly ceased. These convulsions consisted in extensive motions of the whole extremity or of muscles or muscle-groups, and not of simple tremor. If the movements were forcibly controlled, severe pain ensued.

Next to the motor symptoms the sensory are the most important. Pain not infrequently occurs after the recovery of consciousness in the affected limb; it is apt to be sharp, severe, darting and neuralgic in character. This may last at intervals for some days, a dull ache occurring at first between the intermissions. It disappears of itself in time without lasting effects.

Hyperæsthesia may exist at first. Should this continue, or if anæsthesia not due to secondary traumatic conditions should appear later, we should be inclined to place these symptoms in the third class.

Of other symptoms occurring in accidents from currents of high potential, those which seem to be due to the direct action of the electricity are not serious. Buzzing in the ears and a metallic taste in the mouth often occur at the very beginning before the consciousness is involved. Nausea and vomiting frequently occur later. There is often considerable dizziness and vertigo. Patients sometimes complain of sensations as of an electric shock running through the body which occur without cause some hours or even days after the real shock. Some of these sensations are certainly to be reckoned under the mental or psychical symptoms. Susceptibility to the effects of electricity, of lightning, and of thunder-storms, though undoubtedly in many cases psychical, has probably in some cases an actual foundation. This is certainly the case in lightning stroke. On the other hand, in the large majority of cases of electric accidents no such result follows, and in many we are expressly told that such a result was looked for but not found.

The temperature, as affected by the electricity alone and not as secondary result of injuries, is not always easy to determine. It seems to be in most cases lowered at first, being in that of Moyer 97.5° and in that of Robert 97°. Later it may rise to a certain extent, usually to not more than 101°, but here again the influence of traumata is difficult to separate.

The pulse may be full and soft or weak and compressible. It is frequently very feeble, sometimes almost imperceptible, and often rapid. It is apt to remain rapid and somewhat soft for days in severe cases.

The respiration is at first rapid in severe cases unless the shock be so great as to cause its cessation. This rapidity remains for a varying period and then disappears.

As a typical case of the results of shock from an electric wire, we will mention the one reported by Dr. F. W. Jackson. The patient, a man twenty-two years old, came in contact with a live electric-light wire, touching it with his hands. He was thrown a distance of about ten feet and then back again, "swinging back and forth two or three times." His hands were in contact with the wire about three minutes, when the current broke and he fell to the ground unconscious. Was seen two hours later by physician. Temperature 100°; pulse 100, strong and bounding; pupils dilated; headache; nervous and irritable; reflexes increased. The headache was accompanied by insomnia which continued for three days, after which it disappeared, and he resumed work apparently none the worse for his accident. The palmar surfaces of both hands and the anterior surfaces of the forearms were blackened from the tips of the fingers to a point midway between the wrists and the elbows, and these parts were exceedingly sensitive to the touch. The least irritation of the muscles would cause them to contract violently. This condition ceased on the second day. The current was from a fifty-light arc circuit of about 2,100 volts; 6.8 amperes. The accident took place out-of-doors on a very rainy night. The amount of electricity which the patient received was, as in all such cases, very uncertain.

FATAL CURRENT.

The amount of current which will produce a fatal effect varies with the character of the current and with the points of contact. Currents passing through the head or those which affect the pneumogastric nerves are much more dangerous than others of the same character and equal strength passing through one extremity, for example.

The same current will, of course, also produce different effects, according to the facility of its conduction into and through the body, and this depends again on the completeness of the contact and whether the body or the portion thereof concerned enters directly into the circuit or only forms, as it were, a partial conductor and diverts a certain portion only of the current to itself. Again, the condition of the epidermis, whether dry or wet, and the position of the person in relation to good conductors, metallic or otherwise, has much effect.

If the skin and clothes be wet, the resistance to the current is lessened and it passes more readily into the body. In the same way, if a person stands in close relation to a good conductor and places his hand on one wire of a high-tension electric circuit, he will receive a much more severe shock than if not connected with such conductor. Thus a person standing in a pool of water (water is a good conductor), and more strongly if standing on the metallic rail of a railway track, and touching one wire of an electric circuit with one hand, receives a much stronger shock than if he were standing on dry land, or if his boots were rubber or he was otherwise insulated.

The accidents most frequent in practice are those in which the current has been partially diverted from its original course and the person has not entered fully into the circuit. In such cases it is not usually possible to estimate accurately or even approximately the amount of current which the person has received. No calculations can, therefore, be based on these accidents. Again, we find that a person may be seriously or even fatally injured by a current which another person seems to bear with impunity.

D'Arsonval in 1887, in France, advised 500 volts as the maximum for the continuous current and 60 volts as the maximum for the alternating current which might be employed without special permission.

Our only accurate knowledge in regard to fatal currents comes from the experience derived from electrocutions. From these it appears that an alternating current of 1,500 volts is deadly if it passes through the body for more than a few seconds and if the contact is perfect.

Death.—Death may ensue immediately as the result of an electric shock without any evident preliminary symptoms, or it may occur later, either as the direct result of the shock or as the consequence of the exhaustion produced by the burns and other injuries, or directly from the injuries themselves. If death does not occur immediately and if appropriate means of aid are at hand, the sufferer usually survives and the effect of the electric shock gradually passes away. The danger after this arises from the burns and other injuries, and almost all the deaths not immediate are the results of these. The mechanism of death from high-pressure currents has been variously stated. Blaile in a paper read before the American Institute of Electrical Engineers at Niagara Falls, June 27th, 1895, says "death in electric shock is really due to the fact that the current produces a contraction of the arteries through an influence on the nervous system, and that this constriction of the arteries throws in such a mechanical impediment to the flow of the blood as the heart is unable to overcome, and that where drugs are used to counteract the effect much larger doses of electricity can be borne." These views are partially confirmed by the experiments of Oliver and Balann.

ELECTROCUTION.

Electricity has been adopted in the State of New York as the agent for the execution of condemned criminals. This has given rise to much discussion as to what form of current was the best adapted for this purpose and as to what amount was required to produce death at once and painlessly. These questions may now be regarded as practically settled, at least so far as regards the purposes mentioned, and we shall only refer incidentally to the discussions and their results.

Early in 1890 a committee consisting of Dr. Carlos F. MacDonald, Dr. A. D. Rockwell, and Prof. L. H. Laudy made a report to the superintendent of prisons at Albany in regard to the efficiency of the electrical appliances and dynamos placed in the State prisons of Sing Sing, Auburn, and Clinton. This report gave details of various experiments made on animals to determine the amount of current and the time required to produce a fatal result.

On the 6th of August, 1890, occurred the first electrocution, that of William Kemmler, alias John Hart, at Auburn Prison. Dr. MacDonald in his official report to the governor in relation to this says: "It is confidently believed that when all the facts in the case are rightly understood the first execution by electricity will be regarded as a successful experiment. As might have been expected at the first execution by this method, there were certain defects of a minor character in the arrangement and operation of the apparatus. But in spite of these defects the important fact remains that unconsciousness was instantly effected and death was painless."

The efficiency, rapidity, and painlessness of this form of execution have been confirmed by the later experiences. Up to the present date (May 26th, 1892) eight condemned criminals have been executed in the State of New York. Apparently all the officials who are intrusted with the care and inspection of this subject seem satisfied that this is, on the whole, the wisest, easiest, and most effective form of death thus far practised among civilized nations. The *Medico-Legal Journal* of New York, in printing the official report of the recent executions of four men made by Drs. C. F. MacDonald and S. B. Ward to the warden of Sing Sing Prison, states that it furnishes "indisputable evidence of the fact (1) that the deaths were painless and the victims unconscious from the instant of contact; (2) that they were certain and unattended with any of the revolting scenes so frequently witnessed at the scaffold; (3) that the method is humane so far as inflicting physical pain or suffering, and from all sides considered infinitely preferable to the death by hanging; and that so long as capital punishment for murder exists in New York, we need not desire to change the method of punishment." These claims would seem to be thus far substantiated.

The value of this method of execution is now beyond doubt. When properly performed it is rapid, painless, and not repulsive. The criminal has probably no physical sensation of pain or discomfort due to the mode of death from the moment the first shock occurs. Since the rapidity of the transmission of the electric current through the body is in these cases much greater than the rapidity of the transmission of sensation, it seems just to conclude that no sensation from the electricity reaches the consciousness. The only distress suffered by the criminal is the unavoidable mental suffering natural to his position.

The mechanical means employed in electrocution are practically the same at Sing Sing, Clinton, and Auburn prisons. A special room is provided for the purpose, which should be, if possible, in the basement with a concrete floor: this room must be of sufficient size to admit readily the criminal with the attendant officers, the warden and other officials in charge or on duty at the execution, and the witnesses for whom seats are usually provided at a little distance from the criminal's chair, and also to allow of plenty of room for the management of the electrical apparatus, and a good space around the chair in which the criminal is placed. The electrical plant consists of an alternating-current dynamo and its accessories, placed wherever may be convenient, according to the arrangements of the buildings of the institution, but connected by means of wires with the switch-board in the execution-room. In the execution-room also should be the voltmeter, the ammeter, and such other instruments of measurement or precision as may be required. In charge of these and of the switch-board during the execution is the electrical expert, an official paid by the State of New York. Means of communication by electric bells or otherwise are, of course, arranged between the execution-room and the engineer in charge of the dynamo, so that the current can be produced as desired.

The chair in which the criminal is placed is made of stout beams of oak and is securely fastened to the floor and insulated. It is perfectly plain, with broad arms and an upright back, which latter can be tilted backward a little by means of a special arrangement and firmly fixed in the desired position. This is accomplished by means of a bar of wood which is firmly attached at one end to the lower portion of the back and runs forward thence parallel to the seat of the chair and alongside of it; to the anterior end of this is fastened a perpendicular bar running downward, which can be raised or lowered at will, and securely fastened at any height. As this is raised or lowered, it raises or lowers the anterior end of the horizontal beam and correspondingly lowers or raises the opposite end to which the back of the chair is attached, thus moving the latter. When the anterior end of the horizontal bar is raised the posterior end is lowered and the back of the chair is straightened. Attached to the upper portion of the back of the chair is a head-rest, which can be raised or lowered as desired: it may, as in the case of Kemmler, have a horizontal arm which projects forward and from which the head-electrode may be suspended. The chair is also furnished with broad leather straps firmly attached, two of which pass around the body, one around each upper arm, one around each lower arm, and one around each leg. There is also a broad conjoined or compound strap which passes over the head, encircling the forehead and the chin and securing the head firmly to the head-rest. When these straps are properly adjusted and fastened, any marked degree of movement is impossible. The adjustment and fastening of these straps can be performed very rapidly, in practiced hands taking not more than forty seconds.

The electrodes used have varied slightly in different cases. In the case of Kemmler they each consisted of a bell-shaped rubber cup about four inches in diameter, with a wooden handle through which passed the wires into the bell to end in a metallic disk about three inches in diameter, faced with sponge. The upper electrode was so arranged as to rest firmly on the top of the head, where it was held closely by means of a spiral spring: it was attached to the horizontal arm of the head-rest, a sliding arrangement shaped like a figure 4. The lower electrode was in this case attached to the lower part of the back of the chair, and projected forward at a level with the hollow of the sacrum. There was also connected with it a sliding arrangement, and a spiral spring which in connection with a broad strap around the prisoner's lower abdomen rendered contact secure.

In the later executions these electrodes have been somewhat modified and differently applied. The head-electrode is now so formed as to cover the forehead and temples, and can be easily fastened in this position without a spring. The lower electrodes have been applied to the leg in each case, sometimes apparently to the calf and sometimes more to the outer side, where they are securely strapped. They are made of such a shape as to cover a considerable portion of the surface in this region. It is not a matter of importance to which leg the indifferent electrode is attached, but they have actually been applied in most cases to the right leg, though in some they were attached to the left. They are thoroughly moistened, usually with a solution of salt and water, and a drip may be arranged so as to keep them wet during the passage of the current or other means employed to this effect.

The electromotive pressure, as shown by readings of the voltmeter by Professor Laudy, in the cases of Slocum, Smiler, Hood, Jugigo, and Loppy, varied from 1,458 to 1,716 volts. The ammeter showed a variation of from two to seven amperes.

The alternating current in the case of McElvaine made roughly 150 periods per second.

The number of contacts made in each case and the duration of each contact were as follows:

	Number of Contacts.	TIME, SECONDS.			
		1st.	2d.	3d.	4th.
Kemmler	2	17	70	..	..
Slocum	2	27	26	..	..
Smiler	4	10	10	10	19
Hood	3	20	20	20	..
Jugigo	3	15	15	15	..
Loppy	4	15	11	15½	10½
McElvaine	2	50	36	..	..
Tice	4	Total time, 50.			

In the case of McElvaine, the first contact of fifty seconds was made through the hands, the second contact of thirty-six seconds from the head to the leg. The hands were immersed in cells containing tepid salt water, connected respectively with the opposite poles of the dynamo. Kennelly states that in this case, with the hands immersed and the electromotive force at 1,600 volts, the current began at 2.0 amperes, and in fifty seconds had increased to 3.1 amperes, indicating a resistance between the electrodes of from 800 ohms at the beginning to 516 ohms at the end. In the second application from the forehead to the leg with an electromotive force of 1,500 volts, the current amounted to 7.0 amperes during the thirty-six seconds contact, indicating a resistance practically steady at 214 ohms.

Alternating currents of from 1,600 to 1,700 volts and upward may be considered fatal currents, and as capable of producing death when contact is perfect. Dr. MacDonald goes so far as to say: "No human being could survive the passage through his body of an alternating current of more than 1,500 volts for a period of even twenty seconds, contact being perfect."

The physical phenomena caused in the body by electrocution as at present conducted are comparatively simple, and such as we should logically expect. The instant the body of the patient enters into the circuit of the current, all the voluntary muscles appear to be thrown into a condition of violent contraction which continues so long as the current lasts, and on cessation of the current is replaced by a condition of extreme muscular relaxation. All *consciousness* is apparently lost immediately on the application of the current. This probably has never returned in any case, but on the removal of the body from the circuit of the current the relaxation of the muscles causes movement, and sometimes, as in the case of Kemmler, slight spasmodic movements of the chest have occurred. The pupils in this case were dilated. The condition of contraction and rigidity is renewed at each new application of the current, to cease immediately when the current is removed.

In Kemmler chest movements and possibly heart-beat occurred after the first contact, the former perhaps half a minute after the cessation of the current.

In Slocum there were chest movements and radial pulsation after the first contact. In Smiler no movement of the chest, but radial pulsation after the third contact. In Jugigo a slight fluttering of the radial pulse when final contact was broken, which rapidly ceased. In Hood no movement or pulse-beat.

In some of the patients superficial burns have been caused by imperfect contact of the electrodes, either on the head or at the position of the lower electrode. In Kemmler's case the cerebral cortex was somewhat affected under the head-electrode.

The practical effect of the application of the current to the criminal fastened in the death-chair, as seen by the bystander, is that immediately on its reaching him the whole body is straightened and rendered rigid in extension, the extremities tend to straighten out, and the face may grow red and turgid. There is reported at times swelling and turgidity of the neck. The whole body remains in this tetanic, stiffened condition until the removal of the current, when all the muscles relax and the body sinks back into the chair in a state of complete muscular collapse. Since these earlier electrocutions many others have been performed. The method of inflicting the death penalty on condemned criminals was changed from hanging to electrocution in Ohio April 16th, 1896, and electrocution was adopted in Massachusetts, April 13th, 1898. The methods now (1902) in use do not differ essentially from those above described. In Massachusetts machines capable of giving a current of 1,750 volts are used. The ammeter measures from seven to twelve amperes according to the size of the individual and the fulness of the blood-vessels.

MENTAL OR PSYCHICAL SYMPTOMS.

The third class of results which are found after electrical shocks from high-tension currents are the mental or psychical. By the use of these terms we do not wish to imply that they are voluntary. They are, however, so far as our present knowledge of pathology reaches, largely functional. This is precisely the class of cases which, when resulting from railway accidents, are placed under the head of railway-brain or railway-spine. They may be considered in the present state of our knowledge as traumatic functional neuroses, though it is probable that when our means of examination and investigation are more complete we may succeed in discovering a visible or perceptible lesion. The symptoms affecting motion and sensation in these cases are frequently accompanied by others of an emotional character, and in many cases there seem to be partially or wholly voluntary conditions and symptoms with the involuntary. There is in many cases a characteristic loss or diminution of the force and power of volition, but in others this is not perceptible.

These conditions are so well known when produced by other causes that we do not consider it proper to enter into a full consideration of them here, but we cannot leave this important subject without a few general remarks.

No form of affection or disease has caused more discussion among the medical profession or figured more prominently in the courts than this, and even now there are many questions in relation to these conditions still under dispute. Our own view, confirmed both by observation and experience, is that the tendency in New England, at least, has been on the whole to underrate the severity, the duration, and the amount of suffering caused by these conditions. That because there have been cases of malingering, of deception, and of rapid cure after the receipt of damages, and because in addition to this a certain visible emotional and at times apparently controllable element exists, the profession, and above all the laity, are led to conclude that this forms the essential condition and basis of the disease. On the contrary, in a very large proportion of cases the symptoms are such as cannot possibly be voluntarily assumed; they produce extreme discomfort and often much suffering for the patient, and frequently last for years, rendering their victims incapable of carrying on their former occupations.

Fortunately in the patients suffering from electric shock the severer forms of these affections are not so common. In most of the cases reported recovery has been more or less rapid. Cases in which previous hysteria or neurasthenia have existed are more liable to these manifestations than persons of a previously equable nervous constitution, but these latter are by no means wholly exempt. To consider these conditions, as is sometimes done, as the fault of the patient seems to us both unwarrantable and unjust.

LIGHTNING.

We now come to the consideration of the action of electricity in another form, that of natural electricity or lightning. The effects of this are practically the same as those of the forms previously described, except such differences as seem to be fairly accounted for by the vastly greater force of the currents with which we have to deal. Injuries and deaths from lightning stroke have been recognized and described for many centuries, and we have now a large collection of careful observations on them. They occur in most temperate regions with comparative frequency. In France the number of deaths from 1835 to 1852 inclusive (eighteen years) was 1,308. In England, including

Wales, there were in twenty years, 1865 to 1884 inclusive, 416 deaths. In 1846 Mr. Eben Merriam, of Brookline, wrote to Mr. Arago that in the three last years about 150 persons had been killed by lightning in the United States. In thirty years, from 1855 to 1884 inclusive, we find 101 deaths in Massachusetts from this cause.

Exposure.—Injuries and deaths from lightning may occur in various places and under various conditions. The severe lightning strokes are popularly supposed to occur only during thunder-storms, and in this latitude this is undoubtedly, as a rule, true, but lightning strokes are reported to have occurred, particularly in the South, from a clear sky, and there seems no reason to doubt that this may happen. It is said also that dangerous discharges from the earth to the atmosphere may take place at a considerable distance from an atmospheric storm. As a rule, the lightning is more likely to strike some tall object, as a tree or a tower or steeple, and for this reason, and to avoid injury from falling branches, the shelter of trees should not be sought during thunder-storms if lightning stroke be dreaded. Ships at sea are frequently struck by lightning, partly perhaps on account of the height of the masts and partly on account of the metal in or on them.

Lightning obeys the same general laws as the other forms of electricity and naturally follows the paths of least resistance. Persons, therefore, who are in the neighborhood of or in contact with good conductors are in more danger of injury by lightning than when surrounded by or in contact with poor conductors. The proximity or contact of a large metallic object exposed in a thunder-storm is consequently more or less dangerous. On the other hand, the absence of tall objects or of specially good conductors of any kind does not insure safety. In many cases persons in fields are struck, and cases are related of persons struck on the prairies in the West. In Fredet's case a shepherd was found dead in the midst of the barren moors (landes) in Southern France.

More accidents appear to occur directly to persons out-of-doors than to those in houses or other buildings. When inside buildings, persons struck are usually near an open door or window through which the lightning enters, and they are more exposed to danger from this source if there be some metal object or good conductor in the vicinity. Persons carrying or wearing metallic objects render themselves thereby more liable to be injured in this way.

Not only does the liability to injury from lightning vary somewhat according to the exposure or position of the person, both in relation to the free access of the atmospheric air and to the contact with or neighborhood of metallic objects or other good conductors, but also the severity of the injuries may be largely dependent upon what they are wearing or carrying and the condition of their clothing at the time. If the clothing be wet it will act as a good conductor, as will also any metallic object about the person. We have already referred to the action of metallic objects upon the passage of the electricity to and from the body and to the condition of the skin in relation thereto. The laws of conduction and resistance are precisely the same for the electricity of lightning as for the other forms. Hence the greater the resistance to the electricity at the points where it enters or leaves the body, the deeper will be the burn. Thus we find not infrequently that the lightning, in its course from the head to the feet, meets with a chain or a truss, and almost invariably at least a portion of the current follows this, causing a deep burn where it again passes into the skin. All the external burns of the lightning, except the initial one, are determined by the position and conditions of the body, the clothing, and the conductors near. All electricity obeys the same law and, roughly speaking, follows the path or paths of least resistance.

The clothing worn by a person when struck by lightning may be acted upon in the most various ways. Sometimes it is wholly stripped off the unfortunate sufferer, who, as in a case reported by Cook and Boulting, may have to be protected with sacks or other hastily improvised coverings. In a case reported by Nason, a girl of thirteen was struck while in the street and most of her clothes stripped off and torn to shreds, and the top of her hat, which contained steel wires, was torn from the brim. In the case of Wilks the body was stripped entirely naked and absolutely nothing left on except a portion of the left arm of the man's flannel shirt. The clothing is sometimes torn to the finest shreds, like those of a mouse's nest, as described by Van Horn, and in another case (Claes), where the patient was struck while on board ship, his woollen jacket was torn into fine bits, which stuck to the ropes, and the deck was covered with fibres of wool as fine as those of cotton-wool. In this case the woof of the trousers was said to have been wholly destroyed, while the web was untouched.

The clothing is also often burnt. Not only are holes burnt in it as is usually the case at the point where the lightning strikes and at the point where it leaves the body, but it may be set on fire. It may be found smoking or in flames.

Of all portions of the clothing injured, perhaps the coverings of the feet are the most frequently so, as the electricity is very apt to leave the body through the feet, and the resistance opposed is great. Hence the boot or shoe is frequently injured. Sometimes it is pierced as by a bullet, or a large hole is torn in it, or it may be torn to pieces or reduced almost to lint, while the foot remains uninjured. It may be torn, shrivelled, and burnt. In one case the soles of the shoes had disappeared; in another the leg of the boot was clearly divided from the sole and both straps were torn out; while again in another the shoe was carried wholly off.

The amount of injury to the clothing does not necessarily correspond to the amount done to the body. A person may be killed by lightning while the clothing is uninjured. On the other hand, the clothing may be torn to pieces, carried away, or even partially burnt, while the portion of the body underneath remains unhurt.

Symptomatology.—The symptoms of stroke by lightning resemble, in a general way, those due to high-tension currents of electricity. As in the case of the latter, they can be divided into the direct, produced immediately by the lightning itself, and the indirect, or secondary, produced through the medium of other factors.

In the milder cases the person struck feels dazed and benumbed and may or may not lose consciousness for a short time. At the moment struck they may have the sensation of a blow, and they often see a blinding flash. On recovery of their faculties there may be a temporary anæsthesia or weakness of one or more extremities, which rarely lasts more than twenty-four hours. There is a general shock to the system, sometimes slight loss of memory for a time, and occasionally nausea and vomiting. There are often discolorations of the skin of medium extent, and frequently burns and blisters. These persons have usually received the stroke on one extremity or have escaped the full force. In the more severe cases the patient loses consciousness immediately and may continue unconscious for some hours. He passes into a condition of collapse with rapid, feeble pulse and cold extremities, and the pupils are dilated. On recovery of his senses the same symptoms as in the less severe cases, only more pronounced, are found. The loss of memory may be marked and the intellect temporarily weakened, while the weakness and anæsthesia of the extremities persist longer. The external injuries, burns, and wounds are liable to be more severe.

In the fatal cases where death is directly due to the electricity it is usually instantaneous or at least without recovery of consciousness. It may be caused by shock or by apoplexy, *i.e.*, intracranial hemorrhage or by the direct effect of the electricity on the brain. Of course death is often due to burns or to indirect traumatic injuries.

The indirect traumatic injuries caused by lightning are due either to the loss of consciousness of the patient, which causes him to fall and thus sustain injury, or to the direct action of the electricity upon him, knocking him down or throwing him to some distance, sometimes with great violence, or lastly, and perhaps the most frequent cause, to the impact or pressure of objects which are torn or cast down by the electricity and by striking or falling on a person produce great injury. Thus persons have been killed by the fall of buildings, sheds, or trees which were struck by the lightning, or their branches. Of course all kinds of traumata may be produced thus.

The direct external injuries caused by lightning are burns, subcutaneous hemorrhages, discolorations and markings of the skin either dendritic or metallic, lacerations or wounds.

Burns occur in nearly all, perhaps all, severe cases of lightning stroke. They may be of any or all degrees, and may extend over very small points or over the whole or nearly the whole body. They may consist in a simple singeing of the hair, or they may be very deep and extend to the bone. As before stated, the deep burns are found at the points of resistance to the current, at its points of entrance and exit from the body, and, to a lesser degree, at all points where its course is impeded. This occurs wherever the clothes are fastened tightly or pressed against the body, hence especially at the neck, waist, knees, and sometimes at the ankles. The position of the burns is determined, therefore, by the point at which the lightning strikes the person, his position at the moment, and by the arrangement of the dress and the presence of metallic substances. In the large majority of cases the upper portion of the body is the part first touched by the lightning, and thence it descends along the body to the ground. We are apt, therefore, to find a severe burn about the upper portion of the body, the head, neck, or shoulders; then a scorching, singeing, or burning, more or less severe, in the form of a stripe or stripes more or less broad down the body: the burns being deeper where the clothes are tighter or where metallic objects come into contact with or are near the body; and finally a deep burn at the nearest point of contact with the ground, usually the heel or some portion of the foot.

The burns, however, vary greatly. The eyes may be burnt and severely injured or destroyed. The lightning has been known to enter the mouth and burn the mucous membrane within. The deeper burns not infrequently assume the form of holes. In Heusner's cases about twenty whitish-gray spots, varying from the size of a lentil to that of a pea, were found on the soles of the feet. The hair is usually singed and may be burnt off in large areas, or wholly as in a case reported by Bernard.

Wounds.—These may be direct or indirect. We shall speak here only of the first. Like burns they occur usually at the points of greatest resistance, that is, the places of entrance and exit, but they may be found in any part of the body. They may be clean-cut, as if made by a sharp knife, or they may be lacerated and ragged with the edges contused or burnt. They may consist of holes which look as if they had been punched out.

Contusions or ecchymoses. These may also be produced directly by the lightning, and like burns and wounds are most apt to occur where the resistance is greatest. They may be of considerable importance in a medico-legal sense, as in Fredet's case, where there were ecchymoses on the neck similar to those produced by the fingers of a hand applied for strangulation. In the case related by Cook and Boulting the right side of the body appeared like an exaggerated example of post-mortem staining. There are sometimes found also dark-brown spots, small or large, which may be soft and, when cut, containing fluid blood, or they may be hard and like parchment, dry, and bloodless on section.

Closely connected with these are the so-called dendroid or dendritic marks, which are dark-colored reddish bands or stripes, often more or less dichotomously branched, not disappearing under pressure, found on the bodies of those struck by lightning. Though usually of the form mentioned, they may assume other shapes, as that of an irregular star with zigzag rays. Balfour has figured an excellent example of these.

Metallic staining of the skin has been known to occur where metals were in contact with it at the time of the lightning stroke. These stains may be permanent and are due to the introduction of the finely divided metal. Richardson has succeeded in producing this artificially in animals. He found two conditions required, that the metallic conductor should be sufficiently fine to offer resistance to the current and that the current itself should be an electric discharge of low tension.

Loss of hair is said to have occurred from lightning, though the hair was not burnt. One case has been reported where after a severe stroke all the hair on the body is said to have fallen out.

SYMPTOMS.

Under this heading we shall consider only such symptoms as are, so far as can be ascertained, the direct result of the electricity and not those secondary to injuries.

We will consider first those relating to the nervous system.

Loss of Consciousness.—This occurs to a greater or less extent in all but the very mildest cases. It varies throughout all degrees from a slight momentary benumbing of the faculties to the most profound stupor or coma. It may then last hours or even days. On recovery the patient is apt to have some loss of memory, to be dazed and confused for some time, and a certain obtuseness or blunting of the intellectual faculties may persist for a considerable period. This loss of consciousness is often accompanied by flushing of the face and dilatation of the pupils, or on the other hand the patient may present all the symptoms of collapse.

Loss of memory in regard to the lightning stroke after recovery of consciousness is not rare. It is frequently complete so far as any recollection of the lightning goes, and there may be no remembrance of the thunder-storm. Sometimes a defective memory persists together with general mental impairment (James).

Mental Disease.—A condition of mental impairment lasting at least weeks or months may occur. Mania and the delirium of terror are said to have occurred.

Various symptoms of the disturbance of the nervous equilibrium are not uncommon. Among these we may mention tremor, insomnia, and nervous dread of thunder-storms and of electricity. It is said that some persons who have been exposed to lightning stroke do, at least for a time, become unusually susceptible to the influences of atmospheric electricity.

Loss of Motion—Paralysis.—This is a very frequent result of a stroke from lightning. Hemiplegia is not uncommon. In Bonnet's case the patient was struck on the head by the lightning, which caused a lacerated wound in the left temple, but did not injure the aponeurosis. On recovery of consciousness the patient was found to have a left hemiplegia involving the face and both extremities accompanied by a diminution of sensation over the left half of the body. The sensation became normal in two days, but a partial hemiplegia remained permanently. In the case of Durand there was a nearly complete right hemiplegia with accompanying hyperæsthesia and some affection of speech. Deglutition and mastication were difficult, and there was persistent hiccough. There was photophobia and hyperæsthesia. The patient improved in two weeks and finally recovered. There is often a temporary hemiplegia.

Nearly all forms of paralyses of the extremities may occur. We may have paralysis of all the extremities or of both arms or legs, or monoplegias. Paraplegia occurs not very rarely. It is usually of short duration. It may be accompanied by paralysis of the bladder. Single muscles or muscle groups only may be affected.

Ptosis may occur with paralysis of other branches of the third nerve, causing diplopia. Facial paralysis occurs also alone; in one case it lasted only twenty-four hours, in another one month.

Difficulty in mastication is sometimes found, but much more frequently difficulty in deglutition is reported.

Retention of urine, dysuria, or incontinentia urinæ may all occur, and there is sometimes a paralysis of the rectum, usually temporary, and sometimes obstinate constipation, which in one case was combined with paralysis of the bladder and monoplegia.

Aphasia in various degrees and various forms of dysphasia or difficulty in speech are not uncommon. They are apt to be temporary.

Loss of co-ordination in the lower extremities with partial paralysis of bladder and rectum is reported.

Convulsions.—Epilepsy may be brought on by lightning: this would be more likely to occur in a person previously subject to epileptic attacks. Hysterical convulsions and spasms may also be produced, both immediately and as a more remote result, usually in persons predisposed. Tetany and catalepsy are said to occur.

Clonic spasms of the whole body and convulsive movements of the limbs are not very infrequent. In some cases a marked sensitiveness remains for a time in the limbs struck, so that if touched they are immediately thrown into clonic spasms.

Disturbances of Sensation.—*Pain* occurs in nearly all cases. It is most frequently a secondary result of the burns and other injuries. Not rarely, however, it exists as a direct symptom in the form of a burning or stinging neuralgia in the limb or limbs affected. Sometimes the first sensation on the recovery of consciousness seems to be pain all over the body or confined to some portions only, but the amount and character of the pain, aside from that produced by the injuries, varies much. One patient had a burning pain in the back and leg lasting only half an hour after recovery of consciousness. In another case there were pains all over at the end of the first week. On the whole, severe pain in some or all of the limbs, and less commonly in the head, without paralysis and lasting some days is not rare. In one case reported by Paige the patient had intense pain in the head, neck, arms, and chest; that in the head was constant, severe, and lasted seven days, elsewhere less constant.

Pain in the arms accompanied by paralysis and anæsthesia and lasting three months has been reported.

Headache is not rare as a later or secondary symptom.

Disturbances of sensation other than pain are not rare.

A certain amount of hyperæsthesia almost always exists in the portion affected immediately after the stroke. This is often so marked that it cannot be wholly due to the burns or other injuries. It is usually very temporary and ceases in a few hours. In some cases a permanent or lasting sensitiveness to the action of electricity is said to remain.

Anæsthesia, loss or diminution of sensation, occurs either with or without paralysis. In the cases reported by Balfour, one boy said he could not feel his legs and another that his arms were cut off. In a case reported by Free there was loss of sensation in the right upper extremity from the elbow to the fingers and in the left lower extremity from the knee to the toes. As a rule, the loss of sensation is temporary and quickly passes away, but it may last, in company with paralysis, for some time. In such cases either an organic lesion or a traumatic neurosis is to be suspected.

Paræsthesiæ are very common after lightning stroke. Most frequent, perhaps, is the subjective sensation of numbness. Tingling, formication, and the sense of "pins and needles" may occur.

Reflexes.—As a rule, the deep reflexes seem to remain normal. The superficial reflexes of the parts affected are at least temporarily increased.

Special Senses.—*Sight.*—Affections of the eye. The eye and the surrounding parts may be directly injured by burning. We also find many serious conditions caused by the lightning the pathology of which will be considered later. When a person is first struck he may perceive a flash of light or a ball of fire before losing consciousness. While unconscious the pupils are usually dilated, but react. Sight may be at once totally lost, but this is usually only temporary. There may be amblyopia; photophobia, lachrymation, and pain are not uncommon for a time. Cataract may be produced and other severe ocular affections may result.

Hearing.—Sudden and total deafness may be caused by lightning, as in the case of Cook, where perforation of both tympana was found. This may prove to be only temporary, as in the case of Nason, where the patient, though totally deaf at first, is reported as hearing fairly on the fifth day; on the seventeenth day, however, the hearing was still dull. The deafness may be permanent. With deafness tinnitus is apt to occur. Hyperacustia, or extreme sensitiveness to noise, has also been reported in several cases.

Smell and Taste.—The person affected sometimes has noticed a smell resembling that of sulphur, and this has also been said to have been apparent to others. A metallic taste in the mouth is not rare.

General Symptoms.—When first struck by lightning and while still unconscious, the patient has usually a flushed and reddened face, with dilated pupils. Immediately following, or perhaps without this preliminary stage, appear the symptoms of collapse. Cyanosis may occur, and the patient may appear to be asphyxiated.

Fever, not caused by injuries, may sometimes occur, but certainly not to any extreme degree. In many cases the temperature when taken was normal, and even in cases of severe stroke without serious surgical injury the temperature has not risen above 101°. In these latter cases it is hard to say how far the temperature is affected by the burns which are always present.

The pulse is sometimes slow, sometimes rapid and feeble, or almost imperceptible; at times it is irregular.

The respiration is apt to be labored. In Paige's case there was marked dyspnœa. It may be almost imperceptible. It is sometimes slow and sometimes rapid.

Nausea and vomiting occur often after recovery of consciousness. Vertigo and reeling may exist from various causes.

It is probable that seminal emissions may occur at the moment of shock.

Menstruation, when present, may be checked or may continue. Pregnant women do not necessarily abort.

PATHOLOGY AND PATHOLOGICAL ANATOMY.

A few words must be said in regard to the pathological conditions which may be directly produced by lightning and can be detected during life. The burns, wounds, ecchymoses, dendritic marks, and other external signs have already been fully considered.

Certain pathological changes, however, have been found in the eyes which are capable of being verified during life. In addition to swelling and œdema of the lids, to the injuries from burns and to the various paralyses of the ocular muscles, changes in the tissues of the eye itself may occur. In the first place we may find corneal opacities and adhesive iritis. Irido-cyclitis may occur. Cataract formation is not rare, and its causation has given rise to many theories. Optic neuritis and neuro-retinitis are sometimes found; and we have sometimes optic atrophy. Structural changes in the choroid may also be caused by lightning. Rupture of the choroid, hemorrhage from the choroid and retina, and partial detachment of the retina may occur from the shock without the patient being struck by the lightning and without rupture of the external tissues.

Ears.—Perforation of the tympanum is reported in more than one case.

AUTOPSIES.

We shall consider here the pathological conditions found in deaths from electricity, whether due to artificial or to atmospheric sources. The results are or may be the same in either, so far as we now know, and it is probable that the action of the electricity is practically the same in either case, only varying as regards the strength and tension of the current.

Rigor Mortis.—This has generally been found in cases of death from artificial electricity. In the case of Jugigo, who was executed by electricity, it was present four and one-half hours after death. As regards its occurrence in death by lightning and the rapidity of its onset, there has been much discussion. It is certainly present in many cases, and the probability is there is nothing diagnostic in regard to it in deaths by lightning. When absent, its absence is probably due to the presence of some external factor and has no relation to the form of death. We have, on the other hand, no proof that the rapidity of its onset is increased.

Coagulation of the Blood.—It has been observed frequently that the blood of persons struck by lightning does not coagulate readily. Sullivan states that in certain cases of complete disorganization after lightning shock the blood is left fluid and incoagulable and its color changed to a deep black.

In one of the cases of death from artificial electricity reported by Grange, the heart was found sixty-two hours after death to be filled with liquid blood of a rosy vermilion color, which quickly became darker on contact with the air. A spectroscopic examination of the blood showed the normal lines of oxidized blood reducible by sulphydrate of ammonium. In a case reported by Matzinger the blood as submitted was black and perfectly fluid, the corpuscles, both red and white, were normal, and no fibrin was detected. In a case reported by Kenyeres (1894) the blood was spectroscopically and microscopically normal. In those executed by electricity the blood seems to have been fluid and not in any way remarkable.

There seems to be no evidence that the bodies of those dying from electricity in any form suffer unusually rapid decomposition.

The only absolute sign of death from electricity is decomposition of the tissues, but the usual signs are to be relied upon to the same extent as in ordinary cases of death.

Internal Organs.—In the cases of death from mechanical electricity no changes in the internal organs other than those due to accidental traumata have been found, except a considerable degree of congestion and sometimes minute hemorrhages in the heart substance beneath the pericardium and into the pulmonary air-vesicles and pleura. Dürck (1895) reports a case in which hemorrhagic leptomeningitis was found. In one of Grange's cases the heart was filled with liquid blood; in the other it was completely empty, the right ventricle collapsed, the walls of the left ventricle hard and contracted.

Careful autopsies were made in the cases of the criminals executed by electricity, but no important changes caused by the electric current have been detected either macroscopically or microscopically. A few petechial spots (Tardieu's spots) are apt to be found underneath the pericardium in the heart tissue and sometimes beneath the pleura. The organs were not extremely congested. In the case of Jugigo the vessels of the spinal cord and its membranes contained if anything less blood than usual. In this case the amount of blood found in the brain seems to have been about normal, the vessels of the dura were moderately dilated and those of the pia "in a medium state of congestion." In the case of Kemmler the portion of the intracranial contents underneath the head-electrode was somewhat affected directly by the heat, the meningeal vessels in the dura were carbonized, and the brain cortex was sensibly hardened to one-sixth of its depth, "where there was a broken line of vascularity." The post-mortem temperature in this case seems to have remained unusually high, being 97° F. in the fourth ventricle and 99° F. at the back of the neck three hours after death in a room where the temperature was only 83°.

In autopsies after death by lightning the results are in general analogous. The brain and its membranes may be anæmic or congested. Effusions of blood may be found beneath the dura or in the brain substance itself, due to the laceration or injury of vessels. Rupture of the brain is said to have occurred, and Phayre reports a case in which the left hemisphere was entirely destroyed and changed into a dark gray homogeneous fluid mass, only a small portion of the corpus callosum remaining. No extravasation of blood, laceration of the vessels or membranes, or injury of the bones was detected.

Ecchymotic spots are frequently found beneath the serous membranes, pericardium, pleura, and peritoneum.

Schmitz states that parenchymatous inflammation of the internal organs may occur, and Sullivan reports a case where the stomach was found to be gangrenous over a large surface, the patient having lived several days. Cases of rupture of the heart, the liver, and the spleen are reported.

Treatment.—The treatment is essentially the same in all cases of injury by electricity, whether through artificial currents or by lightning. If the patient be unconscious artificial respiration should be employed either in the usual manner or by Laborde's method, the rhythmical traction of the tongue. After the recovery of consciousness the treatment should be symptomatic. Amyl nitrite, strychnine, and nitroglycerin have been recommended. Burns must be treated with special care and a very cautious prognosis given. Indirect injuries are to be cared for in accordance with the usual surgical rules. Mental and psychical symptoms have a tendency to pass off spontaneously after a time, but the possibility of a long-lasting hysteria or neurasthenia must not be forgotten.

THE MEDICO-LEGAL CONSIDERATION

OF

DEATH BY MECHANICAL SUFFOCATION

INCLUDING

HANGING AND STRANGULATION.

BY

DANIEL SMITH LAMB, A.M., M.D.,

Pathologist Army Medical Museum, Washington, D.C.; Professor of Anatomy Medical
Department Howard University, Washington; Secretary Association of American Anatomists; Late Acting Assistant Surgeon United States Army;
President of Association of Acting Assistant Surgeons
U. S. A.; Member of Learned Societies.

MECHANICAL SUFFOCATION.

Suffocation is the name applied to both the act of and condition resulting from the deprivation of atmospheric air. If the deprivation is due to mechanical interference, the term MECHANICAL SUFFOCATION is used.

Mechanical interference may be by pressure upon or obstruction within some portion of the respiratory tract. Suffocation by pressure upon the neck is called **hanging** when the constricting force is the weight of the body itself; and **strangulation** in all other cases. German writers designate strangulation by cords, ropes, and the like as *Erdrosselung*, and by the hand as *Erwürgung;* French writers do not make this distinction. In English the word throttling is probably oftener applied to strangulation by the hand than by cords.

The term **suffocation** is also applied in a *special* sense to the act and result of pressure on the mouth, nose, or chest and abdomen, stopping the breathing; or of obstruction within the respiratory tract; or of pressure upon the tract from the œsophagus, etc.; or of breathing of irrespirable gases.

Strangulation is almost always homicidal, hanging almost always suicidal, and suffocation (limited) usually accidental, but also often homicidal.

Strangulation may be admitted, therefore, as including all cases of suffocation by pressure on the neck, whether by cords or the hand; but excluding hanging.

It will facilitate the study of the subject if we use the word ligature as a general term to cover the many forms of cords, ropes, etc., used in strangulation and hanging.

The word GARROTING is often used to indicate the forcible compression of the neck by the hands of thieves. The assault is usually made from behind, and the victim is robbed while the throttling proceeds. The brevity of the process explains why death is not more frequent. The word garroting comes from the Spanish; criminal execution in Spain and Italy is usually by means of the GARROTE, a steel collar which is tightened on the neck of the condemned by a screw. The notorious thugs of the East Indies used sometimes a soft loin-cloth, at others a lasso or long thong with a running noose. In Turkey and some other Eastern countries the bowstring is a common mode of execution.

An examination of the reported cases of strangulation and hanging shows a great variety of forms of ligature: cords, ropes, thread, thongs, lassos, flexible twigs, bamboos, leather straps, girdles, turbans, fishing-nets, collars, cravats and other forms of neckwear, bonnet strings, handkerchiefs, sheets, etc. Women have even strangled themselves with their own hair (Case 34). Stones, sticks, coal, and other hard substances have sometimes been inserted in the ligature to increase the pressure (Cases 36, 38, 42, 43, 44). Drunken and otherwise helpless persons have been strangled by falling forward with the neck against a firm substance.

STRANGULATION.

Symptoms and Treatment.

The symptoms and post-mortem appearances in strangulation will vary, according as the deprivation of air is sudden or gradual, partial or complete; and whether there is coincident pressure on the great arteries, veins, and nerves of the neck.

The deprivation of air disposes to asphyxia; pressure on the great arteries by cutting off the supply of arterial blood to the brain disposes to anæmia of the brain and syncope; pressure on the great veins, by preventing the return of blood to the heart, to congestion of the brain and coma; pressure on the great nerves, the pneumogastrics, to syncope. Statistics of hanging show that in about seventy per cent of cases death is by a mixture of asphyxia and coma. While it is probable that

---

[1] Montagné, Lyon thesis No. 1130, 1895–6 (110 pp.), considers systematically and thoroughly the subject of *manual* strangulation. He lays stress on the frequency of rupture of heart which, however, does not seem to me to be borne out by statistics; Lacassagne seems to be his authority. Salim-Fahri, Lyon thesis No. 1175, same year (100 pp.), considers in the same way strangulation by *ligature;* and especially that of infants. The conclusions of both writers seem to be mainly in accord with those of this article.

the proportion is less in strangulation, yet it is also probable that a mixed result frequently occurs.

Asphyxia is from α priv. and σφύξις, pulse—absence of pulse. Apnœa from α priv. and πνέω, I breathe—absence of breathing. Syncope, συγκοπή, a faint; suspended animation from sudden failure of heart. Coma, κῶμα, deep sleep. Richardson[1] makes the following distinction between asphyxia and apnœa: Asphyxia is difficulty of taking in breath; apnœa is breathlessness. There is asphyxia when the blood from the heart can go to the lungs, but there is no access of air; apnœa, when there is access of air, but the blood fails to reach the lungs. In asphyxia the lungs obstruct the circulation; in apnœa the obstruction is in the heart. In asphyxia the air cannot reach the blood; in apnœa the blood cannot reach the air.

Quinquaud[2] and Fredericq[3] conclude from experiments on animals that asphyxia is due to the deficiency of oxygen, not to the accumulation of carbon dioxide.

Page[4] divides the phenomena witnessed in an animal killed by simply depriving it of air, without interfering with the blood-vessels of the neck, into four stages:

First. A short stage. (In the human subject this stage could scarcely last longer than fifty seconds, which is said to be the extreme limit of the most expert divers. The breath can be held longest if a number of deep breaths have previously been taken, so as to surcharge the blood with oxygen.)

Second. The stage of "*besoin de réspirer*," when the want of air begins to be felt; the animal makes vigorous and violent efforts to overcome the obstacle. This stage may continue for three to four minutes.

Third. Unconsciousness supervenes with irregular and spasmodic movements; efforts at respiration continue.

Fourth. Efforts at respiration cease, but the heart still beats. This stage may last from two to four minutes. Hofmann[5] says that it may last a half-hour. In new-born infants, asphyxiated, it may be quite long.

---

[1] Asclepiad, 1890, vii., pp. 102–117.

[2] Compt. Rendu Soc. Biol., 1890, ii., pp. 383–387.

[3] Archiv. Biol. de Gand., 1887, vii., pp. 217–227.

[4] "On the Value of Certain Signs," etc., Edinburgh, 1873.

[5] "Lehrbuch gericht. Med." 1891, p. 502.

The post-mortem appearances in such an animal were as follows: the lungs were pale, reddish, not much distended; there were a few dilated air-cells toward the anterior border; hemorrhages irregularly dispersed over the surface of the lung, varying in number and size. The right cavities of the heart contained dark fluid blood, the left were empty. The pulmonary artery and systemic veins, even the smallest branches, were gorged with dark blood. Page adds that when the great vessels of the neck are interfered with death may occur "by coma, syncope, and even asthenia."

Colin[1] made twenty-five experiments on horses, and records three of them as follows: they were all strangled with a hempen cord at the middle of the neck. The *first* was quiet till the second or third minute, then there were violent movements and strong efforts to dilate the chest; at four minutes, spasms; four and one-half minutes, quiet; six minutes, pupils dilated, tongue hanging out, limbs flaccid; blood black. *Second horse:* Carotid artery denuded to observe its action. In fifteen seconds, blood nearly black; four and one-quarter minutes, no pulsation in carotids; five and one-half minutes, no respiratory movement; six minutes, heart-beat ceased, except feeble contraction of auricles, which continued till twenty-first minute. *Third horse:* In five minutes respiration ceased; tracheotomy performed, but there was no attempt to breathe; eight minutes, heart ceased to beat. Similar results were obtained in ruminants and in small animals, except that the larger animals lived longer than the smaller.

Faure[2] made the following experiment on a large dog. He tied a cord tightly round its neck; for fifty-five seconds it was quiet, then suddenly it became agitated, threw itself against the wall, rolled on the ground, twisted itself; bloody mucus escaped from the nose and mouth; the teeth were ground together; urine and fæces were passed. The efforts at respiration became very rapid. It fell dead at the end of three and one-half minutes.

The symptoms of strangulation in the human subject resemble closely those just described as occurring in the dog.

The FIRST OR PRELIMINARY STAGE lasts a variable time, according to the suddenness and completeness with which the access of air is prevented; it lasts until there is a demand for the air. In a case of homicide, injuries may be inflicted on the victim in this stage which may have an important bearing on the cause of death. Blows on the head may cause unconsciousness, or even apoplexy; upon the stomach, may cause syncope; stab-wounds may tend to cause death from hemorrhage.

---

[1] Bull. Acad. Méd., 1876, v., p. 763.

[2] Archiv. gén. de Méd., 1856, p. 302.

The SECOND STAGE begins with the demand for air and lasts till unconsciousness supervenes. It is characterized by frantic efforts to breathe, efforts in which the entire body takes part. If the subject is conscious, he is intensely so; the expression of the face is intense; the eyes may protrude, the hands be clinched; the memory is unusually active, and the events of a lifetime may rapidly pass before the mind in a few minutes. The tongue may be thrust between the clinched teeth and bitten; and urine, fæces, and semen may be discharged.

The THIRD STAGE usually appears suddenly, and is characterized by unconsciousness and irregular involuntary movements, *i.e.*, spasms; these may end in opisthotonos; the veins become turgid, and hemorrhages may occur from the eyes, nose, mouth, throat, ears, and into the connective tissues of the lungs, pleura, pericardium, etc. The circulation of venous blood in the arteries is shown by the general lividity, especially where the skin is thin, as the lips and tips of fingers. Hofmann[1] states that coincident with the oncoming of unconsciousness and convulsions the respiratory effort becomes expiratory, followed still later by inspiratory efforts.

The FOURTH STAGE begins with the cessation of spasms and of efforts to breathe. The subject is quiet, but the heart still beats. The stage ends with the cessation of the heart-beat.

Discharges of semen, urine, and fæces may occur in the first and second stages, from terror; in the second and third from the general agitation, and in the third and fourth from paralysis.

Strangulation according to Bernard[2] causes a rise in temperature, varying from one to two degrees (Cent.). He thinks that this is due to the changes from arterial to venous blood, especially in the muscles.

Lukomsky[3] concluded from experiments that in asphyxia both arterial and venous pressure is increased in the systemic circulation, but diminished in the pulmonary artery. The highest degree of blood pressure coincides with the strongest respiratory movements, especially expiration. He also concluded that the Tardieu spots (subpleural ecchymoses) directly depended on the efforts of breathing and blood pressure.

---

[1] "Lehrb. d. ger. Med.," 1891, p. 500.

[2] "Leçons sur les anæsthésiques," Paris, 1875, p. 471.

[3] Viert. f. ger. Med., etc., 1871, xv., pp. 58–96.

Some writers, as Taylor and Tidy, think that death occurs sooner in the human subject than in the lower animals; where the access of air is suddenly and completely prevented death may be immediate. Tardieu says that death follows pressure of the hand sooner than that of a ligature.

Fleischmann[1] placed cords round his own neck between hyoid bone and chin, tied them tightly, sometimes at the side, sometimes at the back, without respiration being interfered with, because there was no pressure on the air passages. But his face grew red, eyes protruded slightly, there was a feeling of great heat in the head, of weight, commencing dizziness, and suddenly a hissing and rustling in his ears. The experiment should stop at this point. The same symptoms occurred from applying the cord over the larynx. The first experiment lasted two minutes, the second a half-minute. The difference was due to the different situation of the cord.

Dr. G. M. Hammond[2] gives an account of a personal experiment in strangulation. He sat down; a towel was passed around his neck, and the ends twisted together, making forcible compression of the neck. At first he had a feeling of warmth and tingling, first in the feet, then passing over the entire body; vision partly lost; his head felt as if it would burst; there was confused roaring in ears, like the sound heard on placing the ear to a shell; he remained conscious. In one minute twenty seconds all sensibility was abolished. After a few minutes' rest a second similar trial was made, with similar results, except that sensibility was lost in fifty-five seconds. A stab with a knife drawing the blood caused no sensation.

Should the subject recover from the immediate effects of the strangulation there may yet be serious secondary results. Among these are convulsions and paralysis; extreme swelling of face, neck, and chest; loss of voice; lesions of larynx and lungs; abscesses. Death may occur suddenly and remotely from one of the sequelæ.[3]

In the **treatment** of strangulation the first indication obviously is to remove the pressure from the neck. Artificial respiration will probably be required, and may be aided by ammonia applied to the nostrils, tickling of the fauces, and galvanism. Colin[4] states that artificial respiration is useless after cessation of heart-beat. (See the treatment by galvanism, under "Suffocation.") If the body is cold, artifical heat by means of hot bottles, etc. Venesection may be necessary. Colin strongly advises venesection to relieve the distention of the heart. Stimulants and light food are often required.

---

[1] Translation in Ann. d'Hyg., 1832, viii., p. 432.

[2] Med. Record, N. Y., 1882, xxii., p. 427.

[3] See Maier (Friedreich's Blat., 1882, p. 460); Moreaud (Virchow's Archiv, 1880, i., p. 648); Petrina (Prag. med. Woch., 1880, No. 39); Wagner (Jahr. f. Psych., 1889, viii.). [Hofmann, "Lehrbuch," pp. 570–572]. See Cases 17, 19, 31.

[4] Bull. Ac. Méd., 1876, v., p. 761.

Limousin[1] recommends the use of oxygen. Cobos[2] experimented on animals by injecting oxygen hypodermically, as a means of artificial respiration. His conclusions are that the oxygen is absorbed and carbon dioxide eliminated in the same place. The oxygen thus introduced causes no trouble. Testevin[3] cures asphyxia by hypodermic injection of ether.

The after-treatment will depend on the after-conditions.

The **prognosis** is good if there is no serious injury to the neck and treatment is promptly applied.

The phenomena, more especially cerebral, which have been observed after resuscitation from strangulation, have been considered by many writers and will be further mentioned *infra*, under "Hanging."

POST-MORTEM APPEARANCES.

The **post-mortem appearances** in strangulation are external and internal.

The external appearances are of two kinds: those directly due to violence and accident and those due to asphyxia.

External Appearances Directly Due to Violence or Accident.—The MARKS on the neck. In some fatal cases there are either no marks at all or they are but slight; this is more likely to be the case in suicides than homicides, and is usually due to the ligature being soft and yielding. The victim of a homicide may, however, first be stunned and afterward strangled.

Marks are said to be plainer after the body has become cold and where subjects have recovered from attempts at suicide.

The marks of the ligature in strangulation usually encircle the neck more completely and more horizontally than in hanging. These conditions may, however, be reversed, because a body may be dragged by the neck after strangulation, and there have been suicides by hanging in whom the mark of the cord was horizontal. As a rule, however, a horizontal mark with the knot on the same level as the cord, especially if below the larynx, suggests strangulation rather than hanging; and if there are several marks the probability is even greater. In compression with the fingers the marks are not in a horizontal but oblique line.

---

[1] Ass. Franç. Av. Sci. (1883), 1884, xii., pp. 1042–1045.

[2] Rev. d'Hyg. thér., 1890, ii., pp. 67–72 and 131–137.

[3] Alger. Méd., 1887, xv., pp. 78–90.

The mark of the ligature is usually circular, well defined, and corresponds closely to the breadth of the ligature; rather depressed, and usually below the larynx. As a rule this depression is not deep; the skin at the bottom of the groove is usually very pale, while the adjacent parts are red or livid. Sometimes the bottom of the groove shows ecchymoses. Neyding[1] says that suggillations in the groove made by the ligature on the neck are rare, but are oftener found in strangulation than hanging, because the conditions favoring their formation are oftener found in strangulation. In most cases the skin and connective tissue of the groove and of the parts in the vicinity show, microscopically, hyperæmias and hemorrhages. Liman[2] states that when we find suggillation in the groove or its vicinity, we may know that some other form of violence has been applied at the same time as that of the ligature or hand. He had not seen suggillation in the furrow either in strangulation or in hanging, except when the injured persons had lived some time, and in cases of twisting of the umbilical cord. The absence of suggillation and ecchymosis was due, he thought, to the pressure on the capillaries. Bremme[3] says that in the subcutaneous connective tissue of the mark of the ligature there is no hemorrhage either in strangulation or hanging, if death occurs at once and the cord is removed at once after death; but if the cord remains for some time after death there may be hemorrhage, or if death does not occur at once whether the ligature is removed or not. It is impossible to distinguish antemortem from post-mortem hemorrhage.

The parchment skin seen in hanging is seldom seen in strangulation. Neyding[4] says that the dryness and induration called parchment skin depend mainly on the amount of excoriation of the skin, and this is greater in hanging. Tardieu explains this frequency as being due to the fact that the constriction in hanging lasts a longer time. Liman has seen the parchment skin in those strangled.

---

[1] Viert. ger. und öff. Med., 1870, xii., pp. 340–369.

[2] Ann. d'Hyg., 1867, xxviii., pp. 388–402.

[3] Viert. f. ger. Med., etc., 1870, xiii., pp. 247–260.

[4] *Loc. cit.*

The violence used may cause ecchymoses and abrasions of the skin of the neck adjacent to the mark of the ligature.

The marks of very different constricting ligatures may be quite similar. Taylor[1] mentions a case in which a soft silk handkerchief was used, and the appearance was the same as that of a narrow cord, due to the tightness with which it was tied.

Where a hard substance like a piece of coal or stone is inserted into the ligature, usually then a soft cloth, and presses directly against some part of the neck, there is usually a corresponding bruise.

Marks of pressure by the thumb and fingers are usually on the front of the neck, and either just above or below the larynx. In many cases these marks are only those of the finger-tips with some scratches. These marks may show definitely the probable size of the assaulting hand, and whether right or left.

Marks of strangulation may disappear rapidly after the removal of the ligature. Assailants usually constrict the neck much more violently than is sufficient to cause death. Marks of violence on the neck are, therefore, greater in strangulation than in hanging.

A great variety of external injuries other than those on the neck have been found in the different cases reported where other forms of violence were used. With few exceptions such additional injuries indicate homicide.

External Appearances Due to Asphyxia.—A few of these have already been given under the caption "Symptoms." If death occurs quickly there may not be any signs of asphyxia. The general LIVIDITY which comes on in the second stage usually remains after death. The face varies in color from violet to black and may be swollen. Casper[2] says that the face has the appearance of any other corpse. Liman[3] found the face livid in only one of fourteen cases. Hofmann[1] says that the cyanosis appears during the agony because of paralysis of the circulation and gravitation of blood. The cyanosis of the face, projection of the eyes, and congestion of the conjunctivæ are due to the expiratory effort. These signs are also seen in fat persons who do not die of strangulation. Tardieu[2] mentions a dotted redness or minute ecchymosis of the conjunctivæ and skin of face, neck, and chest as constant; but this cannot be considered characteristic, because it has been seen, though not so well marked, in death from other causes. It has been found in suffocation from compression of the chest and belly; and also where there is respiratory interference in the prolonged efforts of tedious labor and in convulsions. Liman[3] found it in those who were hung. It is due, according to Hofmann,[4] to increased blood pressure and consequent hemorrhages. It is of importance as tending to show that there was stasis of blood in the head and face during life. Liman[5] found cyanosis in the conjunctivæ, lips, back of mouth, and in the muscles. Maschka[6] in 234 cases of asphyxia found capillary hemorrhages of the eyes and eyelids 87 times.

---

[1] "Med. Jur.," Amer. ed., 1892, p. 411.

[2] Tidy, "Med. Jur.," Amer. ed., 1884, iii., p. 263.

[3] Ann. d'Hyg., 1867, xxviii., p. 393.

Dastre and Morat[7] claim that in asphyxia the cutaneous circulation becomes more active than in the normal state, while at the same time the vessels of the abdominal cavity are contracted. Laffont[8] considers the mechanism of this peripheral dilatation.

Post-mortem stainings (hypostases) are usually darker in strangulation than in other forms of death. They appear soon, as does also putrefaction, because of the quantity and fluidity of the blood.

Corin[9] believes that the fluidity of the blood during life depends on a ferment continuously produced in the blood; that this, of course, ceases at death, and then the tendency to coagulation appears and is due to the formation of *cytoglobin* (probably), and that this substance forms in asphyxia.

Signs of hemorrhage from the nose, eyes, and mouth may be visible; as also bloody froth from the mouth and nose. Chevers[1] never saw bleeding from the ears in strangulation. Taylor[2] states that Dr. Geoghegan informed him of a case of suicidal strangulation by a ribbon; the violence was great, there was bleeding from the ear, and the drum was found ruptured. In this case the mark on the neck, which was deep, nearly disappeared after the ligature was removed. Taylor also says that Wilde, of Dublin, saw a case of rupture of drum and hemorrhage in strangulation. Pellier[3] says that Littré mentions a case of rupture of tympanic membrane in strangulation by a cord. Zoufal and Hofmann have offered explanations of the occurrence (Case 35).

---

[1] "Lehrb. d. ger. Med.," 1891, p. 504.

[2] "Pendaison," etc., 1870, p. 169.

[3] *Op. cit.*, p. 393.

[4] *Op. cit.*, p. 504.

[5] *Op. cit.*, p. 394.

[6] "Handb. ger. Med.," i., 1881, p. 569.

[7] Compt. rend. Soc. Biol. (1879), 1880, i., p. 310.

[8] Compt. rend. Soc. Biol. (1881), 1882, iii., pp. 159–161 and 165–168.

[9] Vier. ger. Med., 1893, v., p. 234.

The FACE usually shows pain and suffering; although sometimes the features are calm. In the latter case there may have been syncope.

The EYES are usually staring, prominent, and congested, and the pupils dilated. Casper[4] doubts their prominence. Budin and Coyne[5] state that in asphyxia the dilation of the pupil progresses to a maximum and then convulsions occur. Ophthalmoscopic examination during the dyspnœa of asphyxia shows a lessened fulness of the retinal vessels.

The TONGUE is often swollen, dark, protruding, and sometimes bitten. Maschka[6] states that if the ligature lies above the hyoid bone, the tongue will be drawn backward; if over or below the bone, the tip of the tongue may appear more or less between the jaws.

The HANDS are usually clinched and may have in their grasp articles which, under the circumstances, have a medicolegal value.

The EXTERNAL GENERATIVE ORGANS are sometimes congested; erection of the penis may have taken place and persisted. The vagina may be moist. Tardieu, Devergie, and Casper[7] deny that these appearances are usual.

INVOLUNTARY DISCHARGES of urine, fæces, and seminal fluid may have occurred. There is nothing characteristic in their appearance.

---

[1] Tidy, *op. cit.*

[2] "Med. Jur.," Am. ed., 1892, p. 413.

[3] Lyon thesis, 1883, No. 188, p. 85.

[4] Tidy, *op. cit.*

[5] Gaz. Méd. de Par., 1875, xlvi., pp. 90–92.

[6] "Handb. ger. Med.," i., p. 571.

[7] Tidy, *op. cit.*

All the external appearances of asphyxia are usually more marked in strangulation than in hanging.

Internal Appearances.—THE MARK. Usually there is hemorrhage into the loose connective tissue under the mark and in the subjacent muscles; in most cases isolated and circumscribed, but sometimes extending beyond the line of the mark. Hemorrhage from compression by the fingers is more marked than that from ligature.[1] Sometimes there is only fulness of the subcutaneous veins.

The CAROTID ARTERIES may suffer rupture of their inner and middle coats, especially in atheromatous subjects and when the compression has been great. Friedberg[2] states that the injury of the carotid, if there is hemorrhage into its middle and internal coats, is a proof that the strangulation occurred during life, and probably from pressure of the fingers on the neck, without any regard to any disease of the artery. He reports two cases. The examiner should be careful not to injure the artery with his forceps. The vessels may contain clots.

The NECK occasionally suffers extreme injury, and, owing to the violence used, this occurs oftener in strangulation than in hanging.[3] Occasionally the neck is broken.

The HYOID bone may be fractured (see Case 5). Maschka[4] saw one case in eighteen of *Erdrosselung* and five cases in fifteen of *Erwürgen*.

The TRACHEA is sometimes torn, or may be folded on itself.

The cartilages of the LARYNX, especially if calcareous, may be fractured. This is more likely to affect the thyroid than cricoid. The fracture would appear to occur only as the result of enormous force; especially in the young in whom the cartilages are so elastic. The experiments of Keiller[5] on cadavers led him to conclude that falls on the larynx, even from a height and with superadded force, are unlikely to fracture that organ; that severe pressure or violent blows against the larynx from before backward may cause fracture; but that severe lateral pressure, as in ordinary throttling, is more likely than other forms of violence to fracture the alæ of the thyroid or even the cricoid cartilages and also the hyoid bone. Taylor[1] states that Dr. Inman, of Liverpool, had informed him of a case of splitting of rings of windpipe from pressure (see Cases 5, 13). Maschka[2] in fifteen cases of choking found six fractures of the larynx.

---

[1] Tardieu, "Pendaison," etc., p. 174.

[2] Virchow's Archiv, 1880, lxxix., p. 409, and 1878, lxxiv., p. 401.

[3] Tidy, "Leg. Med." Am. ed., iii., p. 265.

[4] "Ger. Med.," i., pp. 623 and 632.

[5] Edinb. Med. Jour., 1856, ii., p. 824.

Chailloux[3] has collected eight cases of fracture of larynx in strangulation. They were all made with the fingers. The experiments of Cavasse[4] seem to show that there is no great difficulty in fracturing the thyroid in strangulation. Stevenson[5] reports a case of fracture of thyroid and cricoid cartilages from hand pressure.

Internal Appearances Due to Asphyxia.—The VEINS of the entire body are distended with very dark and very fluid blood, while the arteries, especially in the young, are mostly empty. Experiments on the lower animals have shown that the pulmonary artery and systemic veins to the finest ramifications are distended with dark blood.[6]

Kratter[7] discusses the diagnosis of asphyxia, laying particular stress on retro-mediastinal bleedings, of greater or less quantity, found in asphyxia from a variety of causes; these bleedings, he thinks, depend on displacement, vertical and horizontal, of the descending aorta.

Landergren[8] has an article on the appearances found in the respiratory and circulatory apparatuses in asphyxia. He presents a scheme of the relative irregularity and persistence of the phenomena, and believes that the preterminal pause in respiration is caused by irritation of the vagus and other nerve nuclei in the oblongata. The blood pressure appears to have a dominating influence on this persistence.

THE HEART.—The right side, especially the auricle, is usually full of dark fluid blood, due to the mechanical impediment to the passage of blood through the lungs. If the heart continues to beat after the respiration has ceased the right ventricle is commonly well contracted, like the left cavities, and nearly empty, the lungs being much congested. Sometimes the left cavities of the heart contain blood. This would be most likely to occur if the heart should stop in the diastole. Sometimes clots are found in the right ventricle. Maschka[1] found clots in the heart 25 times in 234 cases of asphyxia.

---

[1] "Med. Jur.," Am. ed., 1892, p. 414.

[2] "Ger. Med.," i., p. 632.

[3] Paris thesis, 1874, No. 291.

[4] Paris thesis, 1859, No. 9.

[5] Guy's Hospital Reports, 1893, xlix., p. 105.

[6] Page, "On the Value of Certain Signs," etc., Edinburgh, 1873.

[7] Vier. ger. Med., 1895, ix., p. 84.

[8] Skandin. Archiv f. Physiolog., 1896, vii., p. 1.

The LUNGS are usually much congested, resembling red hepatization, except that the blood is darker. Hemorrhages (apoplexies) into the substance of the lungs are common. Tardieu found patches of emphysema due to rupture of the surface air-vesicles, giving the surface of the lung the appearance of a layer of white false membrane. Ogston admits this occurrence in pure strangulation but to a less extent in mixed cases. Liman[2] found the lung surface uneven, bosselated, the prominences being of a clearer color and due to emphysema. The lungs were in the same condition of congestion and emphysema in strangulation, suffocation, and hanging. He failed to find the apoplexies which have been described.

The lungs are sometimes anæmic. In healthy young subjects, especially children, the blood-vessels of the lungs often empty themselves after the heart stops. The lungs may, therefore, be bloodless, but emphysematous from the violent efforts to breathe. Page's experiments on the lower animals showed the lungs of a pale reddish color and not much distended; a few dilated air-cells might be seen toward their anterior borders, and there might be small hemorrhages over the surface. His experiments appear to show that subpleural ecchymoses occur as a result of violent and repeated efforts to breathe. Among other experiments[3] he stopped the mouth and nostrils of a young calf long enough to excite violent efforts at respiration; it was then instantly killed by pithing. The lungs were found pale red, not congested, but showed subpleural ecchymoses. Page believed these were due to the changed relation between the capacity of the thorax and volume of lungs. Liman found these ecchymoses in cases of strangulation, hanging, drowning, poisoning, hemorrhage, and œdema of brain, in the new-born, etc. He failed to find them in some cases of suffocation. He believes them due to blood pressure from stasis in the blood-vessels. Ssabinski[4] made many experiments on dogs and cats to ascertain the presence or absence of subpleural ecchymoses in strangulation, drowning, section of pneumogastrics, opening of pleural sac, compression of chest and abdomen, closure of mouth and nose, burial in pulverulent materials, etc. Similar hemorrhages may appear on the mucous and serous membranes, as the respiratory, digestive, and genito-urinary tracts, and pleuræ, pericardium, peritoneum, membranes of brain, and the ependyma. These are sometimes minute and stellate, at others irregular in shape; many are bright-colored. According to Tardieu the punctiform ecchymoses are rarely present except in suffocation. Maschka,[1] in 234 cases of asphyxia, found the lungs congested 135 times, anæmic 10, and œdematous 42. He thinks the subpleural ecchymoses valuable signs of asphyxia. Corin[2] thinks that constriction of the thoracic aorta by the diaphragm, even if it causes increased blood pressure, never causes subpleural ecchymoses, although it favors their occurrence, the blood being usually fluid and uncoagulable. Section of phrenic nerve has no influence on the production of the ecchymoses. They are due to increased blood pressure from strong excitation of the circulatory centres and a greater or less cessation of breathing.

---

[1] "Ger. Med.," i., 573.

[2] Tardieu, "Pendaison," etc., p. 178.

[3] *Op. cit.*, p. 29.

[4] Vier. f. ger. Med., etc., 1867, vii., pp. 140–174.

The BRONCHIAL TUBES are usually full of frothy, bloody mucus, and the mucous membrane is much congested and shows abundant ecchymoses.

The lining membrane of the LARYNX and TRACHEA is always congested and may be livid; the tube may contain bloody froth or blood alone.

Tidy comparing strangulation and hanging concludes that because strangulation is usually homicidal, and greater violence is used, therefore the external marks are more complete in strangulation and the congestion of the air passages is invariably much greater.

Maschka found the PHARYNX cyanotic in 216 of 234 cases of asphyxia.

The other MUCOUS MEMBRANES are generally much congested. Serum is found in the serous cavities.

Maschka[3] considers the rounded, pin-head ecchymoses of the inner surface of the *scalp* and pericranium valuable evidence of asphyxia.

---

[1] "Ger. Med.," i., p. 576.

[2] Vier. ger. Med., 1896, xi., p. 14.

[3] "Ger. Med.," i., p. 572.

The BRAIN and membranes are sometimes congested; occasionally apoplectic. Maschka[1] found congestion of brain and membranes 48 times and anæmia 30 times in 234 cases of asphyxia.

The ABDOMINAL ORGANS are generally darkly congested, although Maschka denies this for the liver and spleen in asphyxia.

The congestion of the viscera generally is doubtless due largely to the prior congestion of lungs and engorgement of heart.

Page[2] experimented on six kittens, strangling three of them by the hand, the other three by ligature. The results of the post-mortem examinations were nearly similar: the veins were full of dark fluid blood; the right cavities of the heart were similarly gorged, the left empty; lungs pale red, not congested and not distended. Brain normal. The differences were in the lungs; in the first series there were many small, irregular, circumscribed, dark-red ecchymoses scattered over the general surface; in the second, a small number of bright-red ecchymoses, somewhat larger than a large pin-head.

Langreuter[3] made some experiments on a cadaver from which enough of the posterior part had been removed to enable him to view the throat. He saw that the lateral digital pressure on the larynx closed the glottis; stronger pressure made the vocal cords override each other. Similar pressure between the larynx and hyoid bone caused apposition of the ary-epiglottic folds and occlusion of the air-passages. He experimented on sixteen bodies to ascertain the effect of blows and pressure on the larynx, with the following results: In eight cases, women, the thyroid cartilage was injured three times, the cricoid four; in eight, men, the thyroid eight and cricoid five. Whence he concluded that the larynx is better protected in women. In the sixteen cases the hyoid bone was fractured ten times.

THE PROOF OF DEATH BY STRANGULATION.

Tidy[4] says that "nothing short of distinct external marks would justify the medical jurist in pronouncing death to be the result of strangulation." On the other hand, Taylor[5] considers the condition of the lungs described as characteristic. Liman[6] did not think there were any internal appearances which could distinguish suffocation, strangulation, and hanging from each other.

---

[1] "Ger. Med.," i., p. 575.

[2] "On the Value of Certain Signs," etc., Edinburgh, 1873, p. 24.

[3] Vier. f. ger. Med., etc., 1886, xlv., p. 295.

[4] "Leg. Med.," Am. ed., iii., p. 267.

[5] "Med. Jur.," Am. ed., 1892, p. 415.

[6] Ann. d'Hyg., 1867, xxviii., pp. 388–402.

In estimating the value of testimony it will be well to consider the following facts:

A victim may be strangled without distinct marks being found. The practice of the thugs shows that this may be done with a soft cloth and carefully regulated pressure without making marks. Taylor,[1] while admitting the possibility, states that this admission "scarcely applies to those cases which require medico-legal investigation."

The person while intoxicated or in an epileptic or hysterical paroxysm may grasp his neck in gasping for air, and leave finger-marks.

Different constricting agents may make quite similar marks. Marks may be made on the neck within a limited time after death, similar to those made during life. Tidy's experiments led him to fix this limit at three hours for ecchymoses and six hours for non-ecchymosed marks. Taylor,[2] however, doubts if such marks could be made one hour after death. He says that the period cannot be stated positively, and probably varies according to the rapidity with which the body cools.

It is, however, unlikely in such post-mortem attempts at deception that the other conditions usual in strangulation would be found—such as lividity and swelling of face; prominence and congestion of eyes; protrusion of tongue; rupture of surface air-vesicles and apoplexies in the lung; congestion of larynx and trachea, etc.

No conclusion can be drawn from the presence or absence of any single appearance.

A cord may be found near a body or even around its neck; there may even be a mark around the neck. These may be attempts at deception.

Marks much like those of violence may be made by tight collars and handkerchiefs remaining until the body is cold.

Cases are reported of bodies having been first strangled and then burnt or hung to cover the crime; and of partial suffocation by gags, followed by or coincident with strangulation (see Cases 18, 20, 24).

---

[1] "Med. Jur.," Am. ed., 1892, p. 416. [2] *Ib.*, p. 415.

In apoplectics with short and full neck we may find at the borders of the folds of skin in the neck one or more depressions, red or livid, that bear some resemblance to the marks of a ligature; but on section there are no ecchymoses.

Froth, tinged with blood, in the air-passages is considered by Tardieu[1] one of the most constant signs of strangulation.

The marks of topical medical applications, as plasters, sinapisms, etc., must not be confounded with marks of violence.

In strangulation by ligature the marks are usually horizontal; in hanging, oblique. In hanging too they are usually dry and parchmenty. Ecchymoses are more marked in strangulation.

The dotted markings of face, neck, and conjunctivæ described by Tardieu are more characteristic of strangulation.

The principal distinctions between strangulation and suffocation would be the absence in the latter of marks on the neck.

Taylor[2] quotes the case of Marguerite Dixblanc, in which the question was raised whether she had strangled her mistress, Madame Riel, or whether the body had been dragged by a rope around the neck. The question was left unsettled by the medical evidence.

The only motive for attempting to simulate strangulation on a corpse would seem to be to inculpate an innocent person.[3]

Both suicides and murderers are usually more violent than is necessary to destroy life; murderers more than suicides.

Putrefaction may cause external marks to disappear.

All marks on a body should be carefully noted; the cavities of the skull, thorax, and abdomen carefully examined; the possibility of death having occurred from other causes, even in strangulation, must be considered.

As Taylor well says, our judgment must not be swayed to the extent of abandoning what is probable for what is merely possible.

In all cases the cord or strangulating ligature should be carefully examined for marks of blood, for adherent hair or other substances. The precise manner in which the cord has been tied should be noted.

---

[1] "Pend.," p. 186.

[2] "Med. Jur.," Am. ed., 1892, p. 415.

[3] *Op. cit.*, p. 415.

STRANGULATION: ACCIDENTAL, SUICIDAL, HOMICIDAL, SIMULATED.

The question whether a case of strangulation is accidental, suicidal, or homicidal is very difficult to answer.

ACCIDENTAL strangulation is rare. If the body has not been disturbed, there is usually no difficulty in arriving at a conclusion; but if disturbed, a satisfactory conclusion may not be reached.

It is worthy of mention that the umbilical cord may be twisted around the neck of a new-born infant and may have caused strangulation; the mark may give the appearance of death by violence.

SUICIDAL strangulation is rare. The experiments of Fleischman (*supra*) suggest that one may commit suicide by compressing his throat with his fingers (see Case 48).

Where a ligature of any kind has been used it is important to notice the number and position of the knots. In a general way a single knot either in front or at the back of the neck might suggest suicide; more than one would suggest homicide. There are, however, exceptions.

Suicide has been committed by mere pressure of a cord fixed at both ends a short distance from the ground; by twisting a rope several times around the neck and then tying it (the coils may continue to compress even after death); by tightening the cord with a stick or other firm substance; by tightening the cords or knots by means of the hands or feet or some portion of the lower limbs; by the use of a woollen garter passed twice around the neck and secured in front by two simple knots, strongly tied one to another. Among the latest cases are the following:

Hervé[1] reports a case of suicidal strangulation in a man sixty-five years old, who fastened a cord with a running noose around his neck and the other end to the foot of the bed; apparently by simply stretching himself backward he made the cord tense. There is an illustration.

Berger[2] also reports a case of a man fifty-five years old who tied a silk handkerchief twice around his neck and twisted one fold with a hand vise.

---

[1] Archiv. méd. d'Angers, 1898, ii., p. 31; also in Archiv. anthrop. crim., 1898, xiii., p. 196.

[2] Zeit. f. Med. Beamte, 1897, x., p. 171.

It is difficult to simulate suicide; requires great skill and premeditation on the part of a murderer. "The attitude of the body, the condition of the dress, the means of strangulation, the presence of marks of violence or of blood on the person of the deceased, on his clothes or the furniture of the room, or both, rope or ligature, are circumstances from which, if observed at the time, important medical inferences may be drawn." The assassin either does too little or too much. Taylor[1] cites a number of cases of simulation.

Strangulation is generally HOMICIDAL. The marks of fingers or of a ligature on the neck suggest homicide. This is true even if the mark is slight; because infants and weakly persons may be strangled by the pressure of the hands on the throat. Even a strong man, suddenly assaulted, may lose his presence of mind and, with that, his power of resistance; with approaching insensibility his strength still further diminishes. This is true even if his assailant is the less powerful. It requires more address to place a ligature on the neck than to strangle with the hand.

A victim may be made insensible by drugs or blows and then strangled by a small amount of compression; or suffocation by gags and strangulation may both be attempted.

The importance of considering the position and number of the knots in a cord is mentioned under suicidal strangulation.

In homicide, in addition to the marks on the neck, there is likely to be evidence of a struggle and marks of violence elsewhere on the body. It is important, therefore, to notice any evidence of such a struggle.

The nature of the cord may assist in identifying the assailant.

It must be remembered that homicidal strangulation may be committed without disturbing noise even when other persons are near.

Simulation.—False accusations of homicidal strangulation are on record. Tardieu[2] states that a distinguished young woman (for some political purpose) was found one evening at the door of her room apparently in great trouble and unable to speak. She first indicated by gestures and then by writing that she had been assaulted by a man who tried to strangle her with his hand, and also struck her twice in the breast with a dagger. She was absolutely mute—did not even attempt to speak—quite contrary to what is always observed in unfinished homicidal strangulation. On examination by Tardieu, no sign of attempt to strangle was found, and the so-called dagger-openings in her dress and corset did not correspond in position. She confessed that she had attempted deception.

---

[1] "Med. Jur.," Am. ed., 1892, p. 419.

[2] "Pend.," p. 208.

The celebrated Roux-Armand[1] case was another instance of attempted deception. A servant named Roux was found on the ground in the cellar of his employer Armand; his hands and legs were tied and there was a cord around his neck. He was partly asphyxiated, but after removal of the ligature from his neck he rapidly recovered, except that he was weak and voiceless. He stated by gestures that he had been struck by his employer on the back of the head with a stick and then bound as described. The next day he could speak. Armand was imprisoned. Tardieu examined carefully into the case and the results may be stated as follows: The asphyxia was incipient, else he could not have so rapidly recovered. The cord around his neck had not been tied—simply wound around several times; the mark was slight and there was no ecchymosis. Although the legs and hands were tied, the hands behind the back, there was no doubt but that Roux could and did tie them himself. He had stated that he had been eleven hours in the cellar, in the situation in which he was found. This could not be true, for a very much shorter time, an hour probably at the furthest, would have caused death, in view of the condition of asphyxia in which he was found. Again, if his limbs had been bound for so long, they would have been swollen and discolored; but they were not. Again, if the ligature had been around his neck so long as he said, the impression of it would have been more marked. Again, if his stertorous breathing had lasted long it would have been heard by neighbors. The injury on the back of the head, said to be due to a blow, was believed by Tardieu to be due to dragging him on the ground. He further had stated that when he received the blow on the head he became unconscious, and yet he also described how Armand bound him after knocking him down. Again, he had made no outcry; but if he had been strangled while partly unconscious and afterward recovered his senses, he would have been unable to give an account of the matter; if, however, he had been strangled while conscious, there was no reason why he should not have cried out. His inability to speak the first day was assumed, because what was a simulation of absolute mutism should have been simply a loss of voice. The innocence of Armand was ultimately established.

ILLUSTRATIVE CASES.

HOMICIDE.

1. *Cullingworth: Lancet, May* 1st, 1875, *p.* 608.—Woman. Believed to have been intoxicated. Face, especially right side, swollen and livid; a little blood had oozed from mouth, nose, and inner angle of each eye. Immediately over (in front of?) larynx and on each side of middle line were marks of irregular outline such as might be caused by pressure of thumb and fingers. Several dark, bruise-like discolor-

---

[1] "Pend.," p. 242.

ations on flexor surface of each forearm. Hands clinched. Elbows flexed. Discharge of fæces by rectum. Necroscopy: Brain and membranes normal. Hyoid bone and laryngeal cartilages uninjured. Mucous membrane of larynx and trachea congested and covered with frothy mucus. Lungs intensely congested. Several hemorrhages; masses of tissue of each lung, chiefly toward base, were solidified by effused blood. All the heart cavities empty. Stomach normal, empty. No congestion of abdominal viscera.

2. *Taylor: "Med. Jur.," Am. Ed.*, 1892, *p.* 412.—Man and woman. Strangled by cord, tied so tightly that there was hemorrhage from mouth and nose.

3. *Harvey: Indian Med. Gaz., December* 1st, 1875, *p.* 312.—Hindoo woman, age 45. Strangled with the right hand. Necroscopy: Two contusions and abrasions on temple. Neck discolored from right to left jugulars; marks of thumb on right side and three fingers on left, extending from jugulars to windpipe. Eyes half protruded. Tongue discolored. Blood-vessels full of clots. Brain congested (?) and showed external hemorrhages (?). Lungs normal. Heart empty. Liver ruptured to the extent of four inches, with adherent blood-clot. Spleen, stomach, and intestines normal. Muscles of chest, both sides, congested, discolored, and there were clots of blood over and under them. First six ribs of left side and first three of right fractured.

4. *Harris: Ibid., p.* 313.—Boy, age 10. Abrasions over front of neck, especially near left ear, probably from ligature; also abrasion on upper part of chest, probably from forcible pressure. Underneath these marks the veins were much distended. Trachea minutely congested; contained much frothy fluid. Lungs showed rupture of some of the air-vesicles; entire tissues distended with blood and frothy fluid. Dark fluid blood in both sides of heart. Large quantity of fluid in pericardium. Brain much congested. Eyes congested. Tip of tongue between teeth. Other organs normal.

5. *Mackenzie: Ibid., February*, 1889, *p.* 44.—Hindoo woman, age not given, strangled by another, stronger woman. Necroscopy: Abrasion on front and lower part of neck just above sternum and clavicles; four inches long, three broad; five superficial lacerated wounds on sides of neck, four on left, one on right, apparently nail scratches. Two contusions below and behind lower jaw. Also contusions on thighs. No spots of ecchymosis on neck. Contusion under skin of lower part of neck and upper part of chest, eight inches long, four broad. Left greater cornu of hyoid bone fractured. Both upper cornua of thyroid cartilage fractured; cricoid fractured on each side. Larynx, trachea, and bronchi contained pink frothy mucus; mucous membrane congested. Lungs much congested; pink frothy mucus in bronchi; no emphysema nor apoplexies. Right side of heart full of dark blood; left side empty. Liver, spleen, and kidneys congested. Stomach and

intestines normal. Bladder empty. Internal genitals normal. Brain congested.

6. *Mackenzie: Ibid., August*, 1888, *p.* 232.—Hindoo man, age about 30. Strangled by soft cloth cord. Necroscopy: Circular mark of cord, one-fourth inch diameter around lower part of neck; indistinct in front, but distinct at sides and back. Superficial abrasions of lips and right cheek as from a gag. Faint marks of blisters on temples. Fingers not clinched. Face livid, swollen. Eyes closed; conjunctivæ congested; corneæ hazy; pupils normal. Tongue protruding and bitten; not swollen. Fluid blood oozing from mouth and nose. Clotted blood under scalp of left temple. Skin beneath cord had the color and consistence of parchment. Muscles not torn. Hyoid, thyroid, and cricoid not injured. Larynx, trachea, and bronchi empty; congested. Lungs much congested. Some dark fluid blood in right side of heart; left side empty. Liver, spleen, and kidneys congested. Small patch of congestion in stomach. Intestines normal. Bladder normal, contained some urine. Brain congested.

7. *Ibid., p.* 234.—Hindoo woman, age about 40. Broad, circular, depressed "parchment" mark, one inch broad, around the neck, between hyoid bone and thyroid cartilage; made by two pieces of cloth, each three feet seven inches long and one inch broad, twisted into a single cord and tied tightly by three ordinary knots on right side of neck. Superficial wound on left side of head above ear. Face turgid, swollen. Eyes closed. Tongue between teeth and bitten; not swollen. Muscles of neck uninjured. Trachea uninjured. Lungs congested. Right side of heart full of dark fluid blood; left side empty. Liver and spleen congested. Other organs, including brain, normal.

8. *Ibid., p.* 235.—Hindoo woman, age about 25. Piece of cloth twisted tightly twice around mouth. Double cord made of two twists of thin coir rope tied tightly around middle of neck just below thyroid cartilage; beneath the cord the skin was "parchment" like. No injury to muscles of neck nor windpipe. Eyes closed. Face not flushed. Tongue not ruptured nor bitten. Hands not clinched. Larynx, trachea, and lungs congested. Right side of heart full of dark fluid blood; a little fluid blood in left. Liver, spleen, and kidneys congested. Other organs, including brain, normal. Dr. Mackenzie considered death to be due to "asphyxia or suffocation."

9. *Harvey: Ibid., January* 1st, 1876, *p.* 2.—Hindoo woman, age 12 or 13. Faint mark on front of neck; none at back. Severe bruise on top of head, under which was much clotted blood, but no fracture. Lungs congested. Clots in right ventricle; left empty. Brain, larynx, and trachea congested. The examiner believed that she had been stunned and then suffocated by pressure of some soft substance against the neck.

10. *Ibid.*—Hindoo man, age 20. Dead seven days; much decompo-

sition and discoloration. Wrists and ankles were bound. The two corners at one end of a cotton *lungi* (turban) were passed one on each side of the neck and fastened in a knot under left angle of jaw. The *lungi* was then passed around the body under the arms, etc., so as to draw upon the neck and be buried deeply in the swollen flesh. Under the bands the skin was blanched; the tissues above the bands were black and much swollen. Lungs, larynx, and trachea much congested. Heart empty.

11. *Ibid.*—Cases of strangulation by sticks and other hard substances. Boy, age 7 or 8. No external marks of violence. There was hemorrhage from mouth and nose. Face swollen and crepitant. Congestion of subcutaneous tissues and bruising of muscles of right side of neck. Mucous membrane of larynx and trachea covered with blood. Lungs much congested; blood in both pleural cavities. Heart empty; bloody serum in pericardium. Brain congested; slight hemorrhage on surface. Abdominal organs normal. Dr. Harvey states that the boy was no doubt strangled by pressure of a *lathi* on his neck.

12. *Ibid.*—In another subject two sticks were tightly tied together, one pressing on the front, the other on the back of the neck, flattening larynx and other soft parts. In the following case some hard substance, like a brick, had been wrapped in a cloth and used for compression. Boy, age 15. Necroscopy: Large dark ecchymosis in subcutaneous tissue of front of neck and upper part of chest. Also marks of violence on chest and left side of face. Dissection of neck showed blood-clot and also laceration of muscles. Trachea folded on itself, showing that compression had lasted several minutes. Tongue protruding and bitten. Eyes closed. Features calm. Trachea much congested. Lungs congested. Great veins of heart and neck full of fluid blood. Heart, dark fluid blood in both sides, mostly in right. Brain and membranes much congested.

13. *Pemberton: Lancet, May* 22d, 1869, *p.* 707.—Woman, age 60. Found dead. Nose partly displaced and cartilages injured. Lips pale. Mouth closed. Lividity of front of neck from jaw to sternum. Cricoid cartilage ossified (cretified ?) and broken on left side; hemorrhage in surrounding tissues. Lungs and heart as usual in suffocation.

14. *Cullingworth: Med. Chron., Manchester*, 1884–85, *i.*, *p.* 577.—Woman, married, found dead. Bruise and ecchymosis beneath the ear; effusion of blood in underlying tissue. Other bruises on face, etc. Several bruises in mouth, on lips and tongue. Blood dark and fluid. Brain and membranes much congested. No marks of injury on throat. Lungs congested; surfaces emphysematous. Heart contained dark fluid blood. Urine and fæces had been discharged.

15. *The Gouffé Case.*—Murdered by Eyraud and Bompard in 1889. *Archiv anthropologie criminelle, Paris*, 1890, *v.*, *pp.* 642–716; *vi.*, 1891, *pp.* 17 and 179. Reports by Bernard, Lacassagne, and others.

Gouffé was decoyed into a room and strangled; afterward his body was tied up, placed in a trunk, and taken some distance away. The murderers fled to America; but eventually Bompard returned to France and Eyraud was captured; both confessed. When found, the body was well advanced in putrefaction; after a very careful examination was identified. He was strangled by the pressure of fingers; the head was afterward wrapped in a cloth which was held in place by five turns of a cord around the neck; traces of the furrows made by these cords were found. Heart empty; no blood in muscles of neck; hyoid bone intact but superior thyroid cornua fractured at base.

16. *Horteloup: Ann. d'Hygiène*, 1873, *xxxix.*, *pp.* 408–416.—Man found dead on some leaves in a fountain at bottom of staircase; skull and spine fractured. The murderers stated that they had struck him on the head with a crutch; then, believing him to be dead, carried him and threw him into the fountain. When examined, his face was livid, tongue between teeth and bitten nearly in two; and three parallel abrasions on left side of neck and one on right; slight wounds about the face in addition to the fractures mentioned. No report of examination of lungs or larynx. Horteloup concluded that the man had been strangled to death, and that when thrown into the fountain, alighting on his head, the jaws were brought together and tongue bitten.

17. *Laennec: Journ. de med. l'ouest*, 1878, *xii.*, *pp.* 68–71.—Woman, age 53; attempted strangulation by her husband. There were slight ecchymoses on each side of neck under angle of jaw, most marked on left side; when seen, she complained of lassitude and lively pain in hypochondria and region of lower ribs antero-laterally; no sign of lesion. She stated that she was awakened from sleep by pressure on neck and chest and feeling of suffocation; she soon lost consciousness and so remained for some hours. Her statements were corroborated by other testimony. Laennec considered the case one of prolonged *syncope* from pressure on carotids.

18. *Lancet*, *ii.*, 1841–42, *p.* 129.—Woman, found dead, her clothing on fire and lower part of her body burnt. Necroscopy showed face and neck swollen as low as thyroid cartilage, and purple; eyes prominent and congested; mouth closed; tongue not noticed; front of neck below swollen part showed two dark-brown hard marks and slight marks also of pressure; on incision the vessels were engorged. Blood, fluid; brain, congested. There were no vesications from the burns and no sign of inflammation.

19. *Alguie: "Étude méd. and exp. de l'homicide réel ou simulé par strangulation, relativement aux attentats dont Maurice Roux a été l'objet," Montpellier*, 1864, *p.* 121.—This essay contains the reports of many interesting experiments on animals and the cadaver. His conclusions in this case were that the victim had first been struck on the neck by a club; then a ligature was placed on the neck, with

many turns, tied tightly, but the knots did not remain tight. [The marks were visible four months afterward.] The assailant then tied the limbs. The victim recovered with temporary loss of voice, memory, etc.

20. *Gatscher: Mittheil. d. Wien. med. Doct. Colleg.*, 1878, *iv.*, *p.* 45.—A man found hanging. The examiner declared that he had hung himself. Eight years afterward, suspicion of violence. A commission appointed. The protocol had shown the blood fluid; a red-brown dry furrow around the neck; ecchymoses in connective tissues of same; the entire back and posterior parts of limbs showed post-mortem suggillation. The commission declared that the man had been strangled, had lain for at least three hours on his back, and then been hung up. The murderer confessed.

21. *Ibid.*, *p.* 46.—Woman, age 50, found dead in bed. Blood fluid; two ecchymoses size of beans in crico-thyroid muscles of each side; patch of hepatization size of fist, in lung; injury of body. The examiner declared that she had been strangled by compression of larynx with two fingers, but he could not say how long the pressure had continued, that is, whether she had died of the strangulation or of the pneumonia. The assailant stated that he had choked her and when she seemed to be dead, had left her. The woman lived alone.

22. *Waidele: Memorabilien*, 1873, *xviii.*, *pp.* 161–167.—Husband and wife quarrelled and fought; he stated that he choked her with her neckhandkerchief, and as she turned round toward him, then choked her with his hand until she died. The examiner declared that she died of asphyxia; there was a brownish-red dry streak on each side of the neck in the laryngeal region corresponding to the handkerchief, and also two small abrasions of skin which might have been made by the hands; he concluded, however, that she had been choked to death by the handkerchief, because there were no ecchymoses.

23. *Rehm: Friedreich's Blätter f. ger. Med.*, 1883, *xxxiv.*, *pp.* 325–332.—Woman, age 37. Choked by the hand on the neck, and at the same time assailant's knee pressed against her abdomen, pressing her against a wall, causing hemorrhage around the pancreas. Death stated as due to asphyxia.

24. *Schüppel: Vier. ger. öff. Med.*, *xiii.*, 1870, *pp.* 140–156.—Woman, just delivered of child, and boy ten years old, were burnt to death in a fire which consumed their house. Examination of the bodies showed upon the neck of the boy a groove, and his tongue protruded. The husband was charged with murder, was imprisoned, and committed suicide.

25. *Weiss: Ibid.*, *xxvii.*, 1877, *pp.* 239–244.—Woman strangulated by the bands of her nightcap.

26. *Isnard and Dieu: Rev. cas jud.*, *Paris*, 1841, *p.* 101.—Man, age 65. Marks of fingers on face and neck. Opinion that he had been assaulted by *two* men. The two murderers confessed.

27. *Friedberg: Gericht. gutacht.*, 1875, *pp.* 211–224.—Woman

found hanging to branch of tree, but in half-lying position, feet on ground. Opinion given that she had been strangled and then hung.

28. *Tardieu: "Pendaison," p.* 223.—New-born infant. Question whether its death was due to asphyxia from compression of neck by the mother with her hand to hasten delivery. He doubted the possibility of the mother thus assisting her child. But the direction of the seven excoriations on its face contradicted the mother's statement. The traces of finger-nails were distinct. The lungs and alimentary canal showed that the child had lived. Opinion given, infanticide.

29. *Ibid., p.* 219.—Woman, advanced in years, habits dissipated; found strangled. Four excoriations on left side of larynx, one on right; blood in subcutaneous tissue. Marks of nails and long scratches on wrist. Injuries on face and left breast. She had been strangled by one hand on her neck while the other was over her mouth and nose. Face livid; eyes congested; frothy bloody liquid flowing from mouth and nose; tongue behind teeth; bloody froth in larynx and trachea; lungs large, much congested, splenized in places, surface emphysematous, looking like white spots; black fluid blood in heart; brain somewhat congested.

30. *Ibid., p.* 216.—Wife of the celebrated painter Gurneray; found dead in bed, where a fire had been placed and slowly burnt and charred her lower limbs, belly, chest, and right hand. A running noose around her neck. Injuries of head; face livid; tongue between teeth; brain normal; mark of cord slight; subcutaneous tissue infiltrated with blood. Marks of pressure on chest; bloody froth in trachea; lungs congested; heart contained fluid blood. Opinion given that she had been struck on head, causing unconsciousness; then partly strangled and partly suffocated by pressure on neck and chest. Body afterward burnt to cover up the crime.

31. *Ibid., p.* 211.—Three murders by one man. All women. All injured about the head and then strangled by both hand and ligature. Two died; one had an odor of alcohol and had apparently not resisted. The third was resuscitated. She was strong and stout, and resisted. Marks of fingers and nails on neck. Afterward she had headaches and giddiness for a long time.

SUICIDE.

32. *Francis: Med. Times and Gaz., December* 2d, 1876, *p.* 634.—Hindoo lunatic, a giant, strangled himself. He passed two or three coils of stout thread around his neck, attached the ends securely to his wrists, and then extended his arms to their utmost limit. This occurred during a ten-minute absence of his attendant, who, returning, found the man had fallen to one side from a kneeling position, with his back against a wall, quite dead. No reason to suspect homicide.

33. *Badahur: Indian Med. Gaz., December*, 1882, *p.* 330.—Hindoo woman, age about 17, strangled herself with the border of her *saree.* Necroscopy: Circular depressed mark caused by the border of a band of cloth, which she had passed in three coils around her neck, the coils tightly overlapping each other; the short ends had been knotted together with a "granny" knot at the back of the neck, like the native women tie up their hair. The coils were so tight that they had to be cut off. Face swollen, dark purple; conjunctivæ congested. Tongue between the shut teeth; bloody froth issuing from mouth and nostrils [the examination was in September, thirty hours after death]. Skin of neck reddened in nearly a continuous line all around, both above and below the band, about three-fourths inch wide, evidently caused by the pressure of the three folds. Considerable ecchymosis above and below the coils; the neck underneath the folds was swollen and red. Brain and membranes much congested. Trachea, pharynx, and œsophagus congested. Lungs congested. Right cavity (auricle?) of heart full, left empty. Liver, spleen, and kidneys congested. Intestinal peritoneum congested. Stomach contained half-digested food. Small intestines empty; fæces in large intestine. Bladder empty. Uterus and appendages congested; no evidence of catamenia.

34. *Harris: Ibid.*—Woman; made a loop of her hair around her neck, knelt down so as to put it on the stretch; when found, was nearly dead.

35. *Geoghegan: Taylor's "Med. Jur.," Am. Ed.*, 1892, *p.* 413.—Informed Dr. Taylor of a suicidal strangulation by a ribbon. The mark on the neck nearly disappeared after removing the ligature. There was bleeding from one ear, from rupture of tympanic membrane. No froth from mouth or nostrils; but little lividity or swelling of face.

36. *Taylor: "Med. Jur.," Am. Ed.*, 1892, *p.* 418.—Boy: found dead with handle of pitchfork under necktie; marks of strangulation on larynx; eyes and tongue protruded; tongue livid and marked by teeth; brain congested. Also man found dead with handkerchief tied around neck and twisted by razor strop. Taylor considered both as suicides. Also a third case (Amer. edit., 1880, p. 465). A man of unsound mind twisted a fishing-net firmly around his neck several times; it remained secure without the aid of a knot.

37. *Fargues: Rec. de mém. de méd., etc., Paris*, 1869, *xxii., pp.* 443, 444.—Soldier, age 32, while drunk, strangled himself with his handkerchief, wrapping many folds around his neck, making a deep furrow without ecchymosis; face pale, eyes closed, lips partly closed.

38. *Borchard: Jour. de méd. de Bordeaux*, 1860, *v., p.* 349 *et seq.*—Collation of cases of suicide by strangulation: First, an officer who placed his sabre scabbard under his cravat. Second, a woman strangled herself with a silk cravat, tightly tied. Third, a man tied the sleeve of his jacket around his neck and fastened the end to a window, so that

the strangulation was partly due to suspension. Fourth, a woman strangled by a cord.

39. *Hofmann: Wien med. Presse*, 1879, *xx., p.* 16, *et seq. Also Lehrbuch, p.* 559.—Woman, age 20, found dead in bath-room, with a thick thread passed three times around the neck, and tied tightly in front at the second and third turns; so tightly that even after cutting the cords the pressure continued. No signs of violence. (Illustration.)

40. *Zillner: Wien med. Woch.*, 1880, *xxx., pp.* 969, 999.—Woman, age 33; found dead on the floor; a neck-handkerchief tied in a firm knot in front of the neck; and underneath, a cord passed twice around the neck and knotted in front in the middle line between the larynx and hyoid bone. Blood was flowing from the ears. No sign of violence or struggle.

41. *Bollinger: Friedreich's Blätter f. ger. Med.*, 1889, *xl., p.* 3.—Man, age 48; melancholic; found dead. Had torn up part of a sheet, fastened it around his neck and the ends around a bedpost, then placed his feet against the farther post and pressed, tightening the ligature. (Illustration.)

42. *Roth: Ibid., p.* 9.—Man, age 68; melancholic; found dead in bed. Had made loose ligature of cravat, tied into it a piece of wood; the ligature lay in front of larynx. Had attempted suicide once before.

43. *Ibid.*—Son-in-law at 36 years of age had committed suicide in the same way.

44. *Ibid.*—Man, age 63; found dead in his bed; cord around neck inclosing piece of wood.

45. *Maschka: Vier. ger. öff. Med.*, 1883, *xxxviii., pp.* 71–77.—Woman, age 45. A cloth was found wound tightly three times around her neck in front of larynx, and tied in a simple knot. There were also injuries of the head. At first it was thought that she had been murdered, but Maschka concluded that she had committed suicide.

46. *Ibid.*—Woman; supposed to have been murdered by her son. There were marks on the neck and other injuries, and hemorrhage into the brain. Maschka concluded that the marks on the neck were not due to strangulation.

47. *Hackel: Dorpat Diss.*, 1891, *p.* 34.—Man, age 48; strangled himself with part of a mattress. Was found lying on his back, dead, holding the ends in his hand. There was a double mark of ligature.

48. *Binner: Zeitsch. f. Med-beamte*, 1888, *i., pp.* 364–368.—Woman; suicided by choking herself with her hands.

For other cases, see Tidy, "Med. Jur.," Cases 20 to 65; Maschka, "Handbuch," p. 625.

ACCIDENT.

49. *Bédié: Rec. de mém. de Méd., etc., Paris*, 1866, *xvi., pp.* 482–484.—Soldier, age 39, found dying, lying on his bed; had returned to

his room drunk and lay down in his uniform. Face much congested; lips cyanosed; eyes closed. Skin of neck below thyroid cartilage showed deep mark from pressure of collar of uniform where the collar was fastened; had passed urine into his clothing. When examined after death his face was pale yellow, lips cyanosed, eyes closed; large hypostatic patches; traces of pressure on neck still visible; lungs congested; larynx, above level of pressure, congested; below was normal. Fibrin clots in both ventricles of heart. Liver, spleen, stomach, and intestines congested. Brain somewhat congested. Bladder contained urine.

50. *Liégey: Jour. de Méd. chir. et pharm., Brussels*, 1868, *xlvi., pp.* 339–342.—Infant, age 8 months, accidentally strangled; it had been placed in its cradle; coverlet over it and held in place by a cord passed across. Some time afterward it was found dead beside the cradle, its head hanging with the right side pressing on the cord. Liégey had the mother replace everything as it had been and satisfied himself that the above statement was correct. When found, the face was pale, eyes and mouth closed; transverse furrow on right side of neck, level of larynx, 3.5 cm. long, one deep; muscles in vicinity congested. Lungs congested. Right side of heart contained clotted blood; left side nearly empty. He concluded that the case was one of accidental strangulation.

51. *Friedberg: Gericht. gutacht., p.* 240.—New-born child found dead in closet. Mother stated that she had taken the child by the neck and drew it into the world. Opinion given that the child had been accidentally choked to death by the hand.

For other cases, see Tidy, "Med. Jur.," Cases 15 to 19, 59, and 62; Maschka, "Handbuch," p. 623.

HANGING.

Hanging is a form of mechanical suffocation by ligature of the neck, in which the constricting force is the weight of the body itself. The French call it "Pendaison" or "Suspension," preferably the former; the Germans, "Erhängen." The expression "incomplete hanging" is applied to those cases in which the subject is partially supported; kneeling, sitting, or otherwise. The same expression has also been used for cases which did not prove fatal.

The pathological effects of hanging are partly those of strangulation, to which must be added the effects of the weight or fall of the body, sustained as it is only by some form of ligature around the neck. These additional injuries will, of course, be proportioned to the weight of the body, length of rope, and suddenness of the fall.

In some countries, as the United States, England, Germany, and Austria, hanging is a mode of capital punishment. It is desirable that for judicial purposes it should be divested, as far as possible, of unnecessarily cruel features; the victim should quickly be made insensible, and death be speedy. Many suggestions to this end have been made, among which is that of Haughton. He recommended that the drop be long, say ten feet, so that the cervical vertebræ may be dislocated. He also advised that the knot be placed under the chin. Others advise that it be placed under the left ear; and others yet, as Barker, of Melbourne,[1] near the spine. In any event the rope should be "freely elastic." G. M. Hammond[2] thinks that the object in judicial hanging should be strangulation, and that the criminal should be pulled up and left to hang thirty minutes; the rope should be soft and flexible so as to closely fit the neck; a weight should be attached to the feet of persons under 150 pounds. Larimore[3] also advocates strangulation instead of attempting dislocation of the vertebræ. Porter[4] suggests that for dislocation the noose be drawn tightly around the neck at the last moment, the knot being either at one side or, still better, in front. Dislocation may be still further assured if a hollow wooden or leaden ball be placed over the knot close to the neck, thus forming a fulcrum to throw the spinal column out of the perpendicular line at the point of pressure.

Hanging is a common mode of suicide, especially in insane asylums and prisons. It is sometimes accidental, and rarely homicidal. It is said to have been attempted for erotic purposes.

The compression of the neck acts in line with the axis of the body; while in strangulation it acts perpendicularly to that axis.

The final cause of death will depend on: 1. The suddenness and completeness of interference with the access of air; asphyxia. 2. Pressure on the large veins of the neck, preventing the return of blood from the head, causing congestion of brain and coma. 3. Pressure on the large arteries of the neck, preventing access of blood to the brain; causing anæmia of the brain and syncope. 4. Injury to spinal cord or pneumogastric nerves or all of them; causing paralysis. A combination of numbers 1 and 2 is usually found in suicidal hanging; and probably all of them in homicidal and judicial hanging. The more protected the air-passages are from pressure the greater part will coma or syncope have in the cause of death.

---

[1] Med. Times and Gaz., 1871, i., p. 671, and 1876, i., p. 93.

[2] Med. Record, N. Y., 1882, xxii., p. 428.

[3] Ohio Med. Record, 1878, ii., pp. 350–352.

[4] Arch. Laryngol., N. Y., 1880, i., p. 144.

Mackenzie,[1] as the result of examination of 130 suicidal hangings, says that 119 died of asphyxia, 8 of asphyxia and apoplexy, 2 of syncope, and 1 of apoplexy alone. Coutagne[2] thinks œdema of the lungs, "œdema carminé," has an important part in causing death.

The following conditions tend to produce asphyxia: a tight ligature, or a loose ligature above the hyoid bone. To produce coma, a loose ligature pressing against the hyoid bone or larynx, especially a cretified larynx. To both asphyxia and congestion of brain, a ligature just beneath the lower jaw, or around lower part of neck.

Baron[3] experimented on twenty-one dogs and concluded that death in them was due to the respiratory obstruction; that pressure on the vagi caused neither congestion nor anæmia of the lungs. He also found that the thinner and more inelastic the ligature the briefer was the asphyxia. Thomas[4] states the following conclusions: All the lesions found in the three great cavities of the hanged and excepting those of the neck, are also found in other kinds of death by asphxyia; and there is nothing in them characteristic of hanging during life. All the lesions of the neck, especially the furrow but not the hemorrhage, may be experimentally produced after death and with the same appearances as during life. Hemorrhage in the superficial and deep tissues of the neck, with or without lesions of vessels, muscles, or bone, can be produced only during life. Whenever, coincident with the furrow, there are lesions of muscles, vessels, and bone, and also hemorrhage, these have been caused by constriction of the neck during life. He believed that a diagnosis of death by hanging rests entirely on the lesions of the neck. Ignatowsky[5] expresses a doubt as to the correctness of Hoffmann's explanation that the rapid occurrence of unconsciousness and death is due to compression of the blood-vessels and vagi. Haberda and Reiner[6] concluded from their experiments that there was a diminution of the lumen of the carotid and vertebral arteries; and to this diminution or closure must be attributed the rapid occurrence of unconsciousness; that paralysis of the heart may occur in diastole, but that it is uncertain whether this results from mechanical irritation of the vagus by ligature or reflex irritation of laryngeal nerve and its branches. Irritation of the nerve could hasten unconsciousness by incomplete closure of vessels supplying the brain and thus prolong the asphyxia. They think that an inhibitory action upon respiratory movements by traumatic irritation of the laryngeal nerve, as suggested by Ignatowsky, is probable. Their paper is criticised by Professor Tamassia, of Padua,[1] and was replied to by them in *Viert. ger. Med.*, 1897, xiii., p. 155.

---

[1] Indian Med. Gaz., 1888, xxiii., p. 299.

[2] Archiv. anthrop. crim., Paris, 1886, i., p. 229.

[3] Paris thesis, No. 422, 1893.

[4] Paris thesis, No. 424, 1893.

[5] Vier. ger. Med., 1893, vi., p. 251.

[6] *Ibid.*, 1894, viii., p. 126.

Hofmann[2] states that when the ligature is placed between the larynx and hyoid bone, the base of the tongue is pushed upward against the posterior wall of the pharynx, completely stopping respiration and causing asphyxia. Taylor[3] states that if the rope presses on or above the larynx, the air-passages are *not* so completely closed as when pressure is below the larynx. In the latter case death would be immediate; in the former a slight amount of respiration might continue. The instantaneous loss of consciousness is due, not to asphyxia alone, but to compression of the large vessels, especially the carotids, against the transverse processes of the vertebræ, causing rupture of the middle and inner coats, and at the same time compression of the jugular veins and pneumogastric nerves. Immediate unconsciousness will almost certainly follow compression of the pneumogastrics. He also believes that the loss of consciousness and of power of self-help occur at the moment that the noose is tightened around the neck. There is no record of any one who attempted suicide by hanging seeking to recover himself, although no doubt some would have done so if the speedy unconsciousness had not prevented. Hofmann mentions the case of a man who was found hanging, and with a loaded revolver in his hand, apparently having intended to shoot as well as hang himself, but lost consciousness before he had time to discharge the revolver. According to him the causes of death are three: occlusion of the air-passages, interruption of passage of blood to brain, and compression of pneumogastric nerves.

---

[1] Giorn. med. leg., 1895, ii., p. 258.

[2] "Lehrbuch f. ger. Med.," 5th ed., 1890–91.

[3] "Med. Jur.," Am. ed., 1892, p. 394.

Von Buhl[1] experimented on cadavers and concluded that in hanging, the epiglottis and arytenoids are pressed over the glottis, and the tongue and the œsophagus against the vertebræ, causing death by apnœa. When the trachea was isolated from the vessels and tied, the air-passages below became dilated and the lungs emphysematous and anæmic. The heart continued to beat and blood to circulate.

The vertebral arteries being much smaller than the carotids, the circulatory disturbance in the brain is not adjusted with sufficient promptness. Compression of the pneumogastrics, according to Waller,[2] has caused subjects to fall to the ground as if struck by lightning. He holds that the unconsciousness in hanging is the result of the compression of the pneumogastric nerves and not of the arteries. Thanhöfer[3] knew a student who had acquired a certain dexterity in compressing these nerves. One day he compressed the two nerves, his pulse stopped and he became unconscious. Thanhöfer[4] tried bilateral compression of pneumogastrics in a young man sentenced to be executed. The pulse fell at once and the heart soon stopped; the eyes were fixed and glassy. It was some time before he regained consciousness and for two days there was *malaise*.

Hofmann says that the compression irritates and, in a higher degree, paralyzes the pneumogastric nerves and causes disturbance of the action of the heart.

Faure[5] denies that the constriction of the vessels of the neck has any effect in the production of symptoms.

Coutagne believes that the pressure on the pneumogastric nerve is a factor in causing death. He hung two dogs; in one the pneumogastric nerves were dissected out and placed in front of the ligature; this dog (No. 1) lived a quarter of an hour and died of pure asphyxia with efforts at inspiration continued to the end. The other dog (No. 2), in which the nerves were compressed, died in five minutes. In both, the abdominal organs were congested and the cavities of the heart were full. The lungs of the first were dry and uniformly red; of the second were resisting, crepitant, and quite œdematous. No subpleural ecchymoses in either. The experiments on animals by Corin[1] led him to conclude that pressure on the pneumogastrics caused increased frequency of the heart-beat and slowing of respiration. Pellier[2] considers the subject quite fully. It would appear that the pressure on the pneumogastrics disposes to stop the action of the heart and cause rapid, perhaps instant death. The pressure on the carotids causes cerebral anæmia and is then only a secondary cause. Levy[3] does not think the action of the pneumogastrics is sufficiently well known.

---

[1] Aertz. Intel. Bl., 1876, xxiii., p. 324.

[2] Practitioner, 1870, iv., p. 193.

[3] Mitt. d. Wien med. Doct. Colleg., 1878, iv., pp. 97–112.

[4] Centralb. f. med. Wiss., 1875, xiii., p. 403.

[5] Arch. gen. de Med., 1856, vii., p. 310.

[6] Archiv. anthrop. crim., Paris, 1886, i., p. 229.

Tidy states that a dog lived for three hours suspended by a rope placed above an opening in the windpipe; and that Smith[4] mentions the case of a criminal who was hung; Chovet tried to save the man by making an opening in the trachea before the execution and introducing a small tube. The man was alive forty-five minutes after the drop, but could not be resuscitated, although the surgeon bled him.

In a small proportion of cases of hanging, homicidal and judicial, death occurs by dislocation of the spine. This is said to have been first noticed by the celebrated Louis, who states that the Paris executioner was in the habit of giving a violent rotary movement to the body of the convict as the trap was sprung, causing a dislocation of the odontoid process and compression of the cord and almost instant death. Taylor[5] says that for dislocation the body must be heavy and the fall long and sudden. Devergie[6] found this to occur in about two per cent of cases. It is said that the Paris hangman placed the slip-knot under the chin in front, which is as Dr. Haughton suggests.

Death may occur from secondary causes after apparent recovery; from congestion of brain and other lesions of the nervous system. These may prove fatal at remote periods. The phenomena, mostly psychical, which have been observed after resuscitation from strangulation, have been discussed by several writers, more especially Wagner,[7] Seydel,[8] Lührmann,[9] Brackman,[1] Schäffer,[2] and Kompe.[3] They consist in unconsciousness, convulsions, amnesia, delirium with hallucinations and somnambulistic conditions. In some cases these symptoms are partly explained by the existence of mental aberration before the strangling. In some cases it is a serious question whether the amnesia is not *retroactive*, that is, whether the individual has not lost the memory of the circumstances and personnel of the violence. Seydel especially discusses this point.

---

[1] Bull. Acad. Roy. Med., 1893, vii., pp. 331–342.

[2] Lyon thesis, 1883, No. 188.

[3] Paris thesis, 1879, No. 172, p. 39.

[4] "Forensic Med.," Appendix, p. 561.

[5] "Med. Jur.," Am. ed., 1892, p. 394.

[6] Tidy, *op. cit.*, p. 240.

[7] Jahr. f. Psych., 1888–89, viii., p. 313.; Wien. klin. Woch., 1891, iv., and Münch. med. Woch., 1893, xl.

[8] Vier. ger. Med., 1894, viii., p. 89.

[9] Allg. Zeit. Psych., 1895, lii., p. 185.

Fracture of the odontoid process according to M. de Fosse is more common than dislocation, and the giving way of the intervertebral substance more likely than either of the others. The phrenic and other respiratory nerves are likely to be paralyzed; the vertebral and carotid arteries may be ruptured. The medulla oblongata is also likely to be fatally injured. Death may also occur from hemorrhage upon the cord, causing pressure.

Besides the ropes used as ligatures in judicial hanging, almost every conceivable article that could be made into the semblance of a cord has been used by suicides; usually, however, some portion of the bedding or clothing. When one resolves on suicide, all the precautions of the managers of prisons and asylums fail to prevent.

The secondary effects in those who recover involve the respiratory organs—dyspnœa, cough, bloody sputa, bronchial râles, and fever; or the nervous system—aphonia, dysphagia, numbness, chilliness, spasms, pains in neck, face, or shoulder; sometimes paralysis of bladder and rectum, and loss of memory. The marks on the neck slowly disappear.[4] Verse[5] collated a number of cases in which the hanging was not completed and the subjects lived for varying periods afterward. Wagner and Möbius[6] discuss the spasmodic seizures and amnesia, which often appear after the restoration from hanging.

Symptoms in Hanging.

Obviously these will be in some respects identical with those of strangulation. In considering the latter, some of the similarities and dissimilarities of symptoms and post-mortem appearances of strangulation and hanging were mentioned.

---

[1] Neurolog. Centralb., 1896, xv., p. 530.

[2] Zeit. med. Beamte, 1897, x., p. 422, and 1898, xi., p. 4.

[3] Neurolog. Centralb., 1897, xvi., p. 312.

[4] Tardieu, "Pendaison," 1870, p. 16.

[5] Lyon thesis, 1891, No. 647.

[6] Münch. med. Woch., 1893, xl., pp. 87–91, 127–129, 194.

Death may be immediate and without symptoms.

There is, of course, no preliminary or "waiting" stage, as in strangulation, except in those rare cases of suicide where the subject inclines his body forward with his neck against the ligature, his body being near the floor or ground. The absence of a drop makes this condition very similar to ordinary strangulation. The body of a victim of homicide might be similarly placed for the purpose of deception, and also that of a subject previously made unconscious; in these cases the symptoms and appearances would resemble those of strangulation.

In other words it is necessary that there should be a drop or fall, or at least the weight of the body, to produce the characteristics of hanging. The jerk of the fall or sudden dependence of the body upon the ligature causes a much greater constriction of the ligature on the neck, and in a different direction, than in strangulation; and also a much greater pressure on the blood-vessels and nerves of the neck.

Tidy divides hanging into three stages:

First stage: Partial stupor lasting thirty seconds to three minutes, according to the length of the drop, the weight of the body, and tightness of the constriction. The testimony seems to be uniform that there is no pain in this stage; indeed, that the feeling is rather one of pleasure.[1] The subjective symptoms described are an intense heat in the head, brilliant flashes of light in the eyes, deafening sounds in the ears, and a heavy numb feeling in the lungs. Sometimes there is a feeling of absence of weight. In many cases efforts to breathe are made for a time after the air-passages are closed. It is doubtful whether there are any voluptuous feelings, as has been suggested.

Chowne[2] reports the case of Hornshawor, "Monsieur Gouffé," who was in the habit of hanging himself for exhibition. He fixed the noose with a knot that would not slip, sprang into it, the rope coming behind the lower jaw and the two sides passing up behind the ears. He would hang for ten to fifteen minutes, and in addition to his own weight would sustain one hundred and fifty pounds. Three times the rope slipped and he would have died but for the help of spectators. He described his sensations as follows: He lost his senses all at once. The instant the rope got in the wrong place he felt as if he could not get his breath, as if some great weight was at his feet; and could not move only to draw himself up; felt as if he wanted to loosen himself but never thought of his hands. He said: "You cannot move your arms or legs to save yourself; you cannot raise your arms; you cannot think."

---

[1] Tracy, Pop. Sci. Mo., 1878, xiii., pp. 349–354.

[2] Lancet, 1847, i., p. 403.

Taylor[1] mentions the case of Scott, the American diver, who was in the habit of making public exhibitions of hanging. The last time he hung for thirteen minutes, the spectators not suspecting that he had died. It is supposed that the ligature had slipped. Taylor also reports a case (from Dr. Elliott) of a boy, age 11, who, to frighten his parents, tied a knot in a handkerchief and put it around a knob and his neck in one continuous ligature. The pressure against the trachea was so effective that he became unconscious and died before he could relieve himself.

Second stage: The subject is unconscious and convulsions usually occur. The convulsed face, however, is a part of the general agitation and does not indicate pain. In judicial cases the face is covered with a cap. Sometimes there are no spasms. Urine, fæces, and semen may be discharged in any stage. Jaquemin, however, in forty-one cases of hanging, noted discharge of urine and fæces only twice. Semen has, however, been found in the urethra where none was ejected externally.[2]

Third stage: All is quiet except the beating of the heart. As a rule, the pulse may be felt for ten minutes.

Blankenship [3] reports an execution of a man by hanging. After the rope was adjusted the pulse was 121; first minute after drop, pulse 54; second minute 52; third 39; fourth 20; fifth 0; sixth 70; seventh 73; eighth 0; ninth 34; not perceptible afterward. Died from strangulation; neck not dislocated. The heart beat once in the nineteenth minute; from the ninth to the nineteenth, only two or three times. No priapism.

In judicial executions, however, the right auricle is found in action when the subject is taken down at the end of the usual period of suspension (see Case 89). Tardieu mentions a case where the heart was beating 80 to the minute one and one-half hours after supposed death. It is probable that in these cases the deprivation of air and compression of the vessels has not been complete. In such cases life may sometimes be restored. Cases are reported where restoration has been possible within a period of a half-hour of suspension; although the fatal period is usually five to eight minutes at most. If, however, the tissues and especially the spinal cord are injured, or the ligature has compressed below the larynx, the chance of recovery is very small, even if the body is cut down at once. According to Faure, animals experimented upon die in twelve to twenty minutes.

---

[1] "Med. Jur.," Am. ed., 1892, p. 396.

[2] See articles of Huppert, Vier. ger. Med., etc., xxiv., pp. 237–252, and Müller-Beninga, Berlin. klin. Woch., 1877, xiv., p. 481.

[3] Jour. Amer. Med. Assn., 1885, i., p. 658.

Many cases of "incomplete" hanging have been reported; where the feet touch the floor, or would do so if the subject should choose to have it so. Tardieu[1] collected 261 cases, in 158 of which the feet touched the ground, in 42 the subject was on his knees, in 29 the body was lying, in 29 sitting and in 3 squatting. Hackel,[2] in 67 cases of hanging, found it incomplete in 34 per cent.

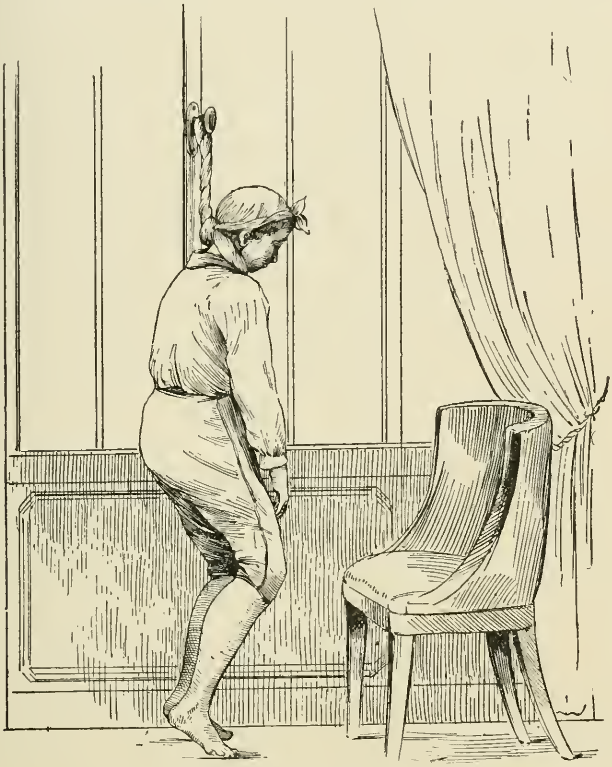


FIG. 22.—Suicide of Prince Condé. (See page 763.)

In one of the experiments of Faure[3] a large dog was hung, his feet touching the ground. For five minutes he was quiet, breathing without difficulty. He then tried to release himself, but instead tightened the knot; he made still greater efforts to release himself, became comatose and fell, apparently dead, at the end of ten minutes; was really dead in twenty-eight minutes.

---

[1] Pend.," etc., p. 22.

[2] Dorpat Diss., 1891.

[3] Arch. gén. de Méd., 1856, vii., p. 315.

In incomplete hanging the upper limbs may have any position; the lower limbs are disposed according to the position of the body (Cases 1, 10, 18, 19, 20, 22, 24, 26, 28, 37, 43, 50, 56).

Faure [1] made many observations on dogs which he killed by hanging. He describes the results as follows: The dog remains quiet usually twenty to thirty seconds, sometimes eight to ten minutes; then becomes violently agitated, the body being thrown forward and backward so powerfully that it bounds to a great height; the head is in motion; the jaws parted; the feet extended or flexed; sometimes brought up to the mouth and neck, trying to remove the obstruction; the inside of the mouth is violet-colored; tongue blackish, livid, may be bitten, often falls backward; the teeth are ground together; the eyes sometimes protrude; conjunctivæ congested; urine and fæces discharged. The agitation lasts two to five minutes, and then the dog gradually becomes quiet. Toward death, however, the agitation is renewed but in a different way; the fore-feet are raised and put forward, the tongue often has a peculiar spasm, the chest is raised, the eyes drawn back into the orbits, pupils contracted; all of this is over within two seconds. Such paroxysms may be repeated half a dozen times. In dying, the eye oscillates from side to side and the pupil dilates. The heart beats some time longer.

Francis Bacon records that he knew a man who wanted to find out by experience if there was any suffering in hanging. He placed the cord around his neck and stepped off a bench, intending to step back again, but became immediately unconscious and would have died but for the opportune arrival of a friend. He said he saw a light before his eyes.

TREATMENT.

The first indications obviously are to let the subject down, and remove all constriction of neck and chest. Artificial respiration should then be used, and this may be assisted by the vapor of ammonia to the nose and tickling the fauces. If the body is warm, cold affusions may be applied to the head and chest, and galvanism may be used.

If the body is cold, apply warmth. Friction of the limbs aids in restoring warmth. If the subject can swallow give stimulants; these may also be used by rectum. Venesection may be required to relieve cerebral congestion or distention of the right heart and pulmonary circulation.

---

[1] *Op. cit.*, p. 308.

The following cases illustrate what may be done to resuscitate one who has been hanged: A man, age 35, in good health, weight one hundred and sixty pounds, was executed with a drop of over six feet; the rope slipped behind the mastoid process. After three minutes his struggles ceased; the radial beat ceased at six and one-half minutes; all signs of life at ten and one-half minutes, and the body was blue. Fourteen and one-half minutes, body let down; mark about one-fourth inch deep on neck; swelling above and below; no fracture of vertebræ. Strong galvanism of the pneumogastrics after sixteen or seventeen minutes at intervals of four seconds caused marked respiratory efforts; sixty-six minutes, galvanism renewed; heart-beat and radial pulse recognized; epiglottis swollen, requiring the tongue to be drawn forward; a few ounces of blood removed; pupils contracted. One hundred and four minutes, galvanism renewed; subject swallowed a little brandy-and-water. One hundred and thirteen minutes, slight muscular action; cornea sensible. One hundred and eighty-six minutes, feet warm, carotid pulsation. Signs of life now increased till six hours after drop, when pupils began to dilate again. Twelve to fifteen ounces of blood were taken and pupils again contracted and pulse beat strong and steady; breathing easy, more regular; eyes followed movements of persons around the room. Died nine hours later, fifteen hours after drop. The experiments were repeatedly interrupted by the sheriff.[1] Taylor[2] reports a case of recovery. Woman, age 44; found hanging from a clothes-line, thrown over a door and fastened to a handle on the other side; her knees on the floor; white froth around the mouth; tongue protruding and swollen; face dusky and swollen; lips dark blue; brown parchment mark on neck; skin abraded over larynx; conjunctiva insensible; pupils dilated and fixed; fingers clinched; limbs flaccid; no reaction from tickling feet; no respiration; faint heart-beat and fine thready pulse. Sylvester's artificial respiration method used at once and continued for four and one-half hours; tongue held forward by forceps. One hundred and fifteen minutes after body was first seen there was spontaneous movement of legs. One hundred and forty-five minutes, conjunctivæ sensible. One hundred and seventy-five minutes, retching. Two hundred and five minutes, free vomiting. She recovered but remembered nothing of the hanging. Keen[3] reports the results of experiments upon a criminal who was executed by hanging. He was cut down about half an hour after the drop. Faradization and galvanization of pneumogastric and recurrent laryngeal nerves caused movements of left vocal cord, but not the right; there was no reflex motion in the larynx. The left phrenic nerve made no response to stimulus. The internal intercostal nerves caused the raising of the cartilage below them (inspiratory), the external intercostals depressed the upper seven ribs (expiratory), and raised the eighth. The other four not examined. The muscles of the face retained their contractility.

---

[1] Lancet, 1871, ii., p. 98.

[2] Glasgow Med. Jour., 1880, xiv., p. 387.

[3] Philadelphia Medical Times, 1875.

Very few, comparatively, however, have been restored after hanging. For cases of recovery see *Medical Times and Gazette*, London, 1871, Vol. I., p. 669 (Cases 12, 13, 42, 44, 47, 49, 66).

POST-MORTEM APPEARANCES.

The post-mortem appearances are external and internal.

The **external** appearances are those due to the action of the ligature on the neck and to other violence, if any has been done, and those due to asphyxia or syncope.

The MARKS of the ligature. If the suspension be very brief and the ligature soft and supple, and the body instantly cut down after death, there may be no mark. Allison[1] questions the value of the mark, contending that it is post mortem, and reports cases; says it is present only if the drop be considerable or the suspension continue after death. Tidy says that the mark is, in a measure, independent of the ligature and duration of suspension, and does not usually acquire its color for some hours after death; sometimes, however, it has occurred in a much shorter time. It may be slight because the ligature has been placed over the clothing. The longer a body hangs after death, the more the mark shows. It can be produced upon the cadaver.

Harvey[2] says: "The characteristic mark is sometimes found in non-fatal cases. . . . In eight instances in the present returns (of nearly 1,500 cases of hanging) there was a distinct mark."

Coutagne,[3] in twenty-four necroscopies on subjects hung, found only slight or doubtful lesions in five cases; but of these, one was in a condition of advanced putrefaction, another was apparently weakened by loss of blood from wounds, and in the other three there were marks of violence. In seventeen cases the lesions of the neck were plain; hemorrhage in connective tissue or muscle.

The direction of the mark is usually oblique, following the line of the lower jaw upward and backward behind the mastoid processes; it may, however, be horizontal. If the ligature encircles the neck more than once, one mark may be circular, the other oblique. If a running noose is used the mark may be circular, and be seen all the way around the neck, looking like the mark of a strangulation. Taylor[4] states that if the noose should be in front, the mark may be circular, the jaw preventing the ligature from rising upward in front as much as it does behind. If it encircles the neck but once, its continuity is apt to be broken by the prominence of the hyoid bone, thyroid cartilage, sterno-mastoid muscles, etc.

---

[1] Lancet, 1869, i., p. 636.

[2] Indian Med. Gaz., 1876, xi., p. 29.

[3] *Op. cit.*, p. 245.

[4] "Med. Jur.," Am. ed., 1892, p. 398.

In four-fifths of the cases (117 out of 143, Tardieu) the mark is found between the chin and larynx; in nearly all the remaining fifth, over the larynx; in a very few below the larynx; the last position is due to the protection of the neck by a handkerchief or beard, or where there is some anatomical or pathological peculiarity which prevents the ligature from going higher.

Hofmann[1] had seen two cases of tumor of neck; one in a woman, where the cord was below the larynx; and in a man where it was over the larynx. He quotes[2] as follows: Remer, above larynx, 38; over larynx, 7; below larynx, 2. Devergie, above larynx, 20; over larynx, 7; below larynx, 1. Casper, above larynx, 59; over larynx, 9. Roth[3] in 49 cases found the ligature mark above the hyoid bone in 5; between the bone and the larynx, 31; over the larynx, 8; below the larynx, 1. Hackel found the ligature in forty per cent of cases between hyoid bone and larynx; in sixty per cent lower down. The ligature always appears lower after the body is laid down than it was in suspension. Maschka found the furrow 147 times in 153 cases above the larynx.

The mark will vary in character according to the kind of ligature used, its mode of application, the vitality of the tissues, and the period that has elapsed since death. The result is different according as the knot or loop is single or double, a running or slip knot.

The mark may differ in character in one part of the neck from another. The same furrow may be soft in one part and dry in another. The width of the mark does not necessarily correspond to the diameter of the ligature. A double mark usually means that the ligature has been twice passed around the neck, although the marks may not be continuous or parallel. Tardieu states that a large single leather thong pressing on the neck only by its borders may make a double mark. The mark is usually *depressed*. The depth of the depression, groove, or furrow, as it is called, is greater the narrower and firmer the ligature, the longer the suspension, and the greater the weight of the body. The mark may be merely a slight depression, without color, or only a red blush, if the subject is young, tissues healthy, and suspension brief. Roth,[1] in 49 cases of hanging, found the furrow of the ligature was brown in 40, red-brown in 6, and 3 times bluish.

---

[1] *Op. cit.*, p. 523.

[2] *Op. cit.*, Levy's translation, 1881, p. 363.

[3] Deutsch. Archiv f. Staats, 1870, xxviii., p. 313.

In about two-thirds of the cases the bottom of the furrow, the place of greatest pressure, is white, especially so where the knot is tied; while the edges of the furrow are usually slightly raised and red or livid. If the subject is very fat, there may be only a slight depression. Harvey[2] says that this hard, white, shining, translucent band from compression of the connective tissue is the first stage of the parchment or vellum skin, and is chiefly noticed in fresh bodies. The borders are swollen and œdematous, called by Lacassagne "*bourrelet de sillon.*"

The skin beyond the furrow is usually violet. Authors differ as to whether this is due to congestion or hemorrhage. Roth[3] in 49 cases found swelling below the furrow 27 times. Hackel found ecchymoses above the mark in thirty-five per cent of the cases of hanging. Hofmann thinks that the lividity of the upper border of the furrow is due to the stopping of the venous blood descending from the head.

The dry, hard, yellowish-brown, or reddish-brown "parchment" furrow, described by writers, is said to be common. Ogston[4] found it in one-third of his cases. It is found only when the body has remained suspended for several hours after death; indeed, may be produced by applying the ligature to the cadaver; is not at all, therefore, a proof of suspension during life. Liman states that constriction by a ligature even for some time does not necessarily cause a mummified or excoriated furrow. He saw cases in which the mark was soft, flat, scarcely colored, but little interrupted, and not parchmenty. The parchment skin seems to depend very much upon a previous excoriation of the skin. Its appearance can be prevented or delayed by examining a body soon after death or by rehanging it; and after it has appeared it will disappear on the application of some liquid. Taylor[5] compares this parchment mark

[1] *Op. cit.*, p. 281.

[2] Indian Med. Gaz., 1876, xi., p. 29.

[3] *Op. cit.*, p. 287.

[4] "Med. Jur.," p. 527.

[5] "Med. Jur.," Am. ed., 1892, p. 399.

to the cutis from which the cuticle has been removed for two or three days.

Slight abrasions and ecchymoses are sometimes found in the furrow. Ecchymoses alone do not indicate whether suspension has been before or after death; but abrasions with hemorrhage strongly suggest suspension during life. Devergie regards ecchymoses of the neck as strongly suggestive of homicide. Neyding[1] says that suggillation in the groove is oftener found in strangulation than hanging. And Bremme[2] that there is no hemorrhage in the subcutaneous tissue of the mark if death occurs at once and the cord is removed at once after death; but if the cord remains for some time after death there may be hemorrhage, or if death does not occur at once, whether the ligature be removed or not.

Roth[3] found ecchymoses or small bladders at the lower margin of the furrow, 9 times in 49 cases. Riechke found only once in 30 cases a hemorrhage beneath and on both sides of the mark. Chevers did not find ecchymoses of the skin of the mark in cases of hanging. Casper found no ecchymoses in 50 of 71 cases. Maschka has seen two cases where burns on the neck resembled mark of ligature.

The furrow, when once distinct, remains constant for a long time after death, even in putrefaction. Marks from soft substances, however, disappear sooner than those from strong and uniform compression.

Schulz[4] discusses ante-mortem and post-mortem strangulation and states his conclusions (pp. 61 to 65): 1. The pressure of the ligature causes changes of form in all the layers of the skin, which microscopically give the same picture whether the marks are ante or post mortem. 2. A leather-like dry mark of the skin, the latter, however, still flexible although deprived of nearly all its moisture, is caused entirely by the pressure of the ligature. 3. A hard, dry, parchment-like, mummified condition of the skin in all its thickness, absolutely devoid of moisture, is caused essentially by persistent strong pressure as in hanging. This dryness is favored by a partial loss of cuticle; for this purpose abrasion of both the mucous and horny layers is not necessary and can only exceptionally occur in the mark. 4. In estimating the value of hemorrhage in the tissue under the mark as well as in injuries of deeper organs of the neck, it is necessary for diagnosis to consider the relation of the hemorrhage in position to hypostasis, to the ligature during strangulation, to the size of the hemorrhage, and the time when strangulation ceases, especially if the hanged person has been cut down. The coagulation of the hemorrhage, as well as an area of œdema, does not exclude a post-mortem origin. 5. In case a hanged person is cut down soon after death and as usual is laid on his back, hemorrhage cannot occur from hypostasis during suspension, but a drop of blood may exude from a torn vessel under and near the ligature and from its direct pressure; and also a small spot of blood may appear in the tissue from laceration of a vessel which lies directly against the ligature; the latter is ante mortem, but may also be post mortem. 6. We have here the most favorable conditions for post-mortem hemorrhage through gravitation. 7. Small hemorrhages of ante-mortem origin occur in subcutaneous connective tissue posteriorly in the skin hypostatically, in and between the muscles of the neck, especially in fracture of vertebræ. 8. But we speak rather of hemorrhages as ante mortem when visible to the naked eye anteriorly in the subcutaneous connective tissue of an absolutely anæmic skin as well as in and between the subjacent musculature of the neck. 9. Hypostatic hemorrhage is, however, possible in the loose connective tissue between the spine and œsophagus and between the œsophagus and air passages, around the great vessels, especially at the upper thyroid cornua. 10. Hypostatic pressure in the neck in the supine position is but slight; the consequent hemorrhages would be small. Larger hemorrhages must have an ante-mortem origin; but what would be a minimum size could not in general be determined. In individual cases we would have to consider the fulness of the neighboring vessels and their size, and perhaps also whether the hemorrhage might not be from many small torn vessels. 11. Should the body hang a longer time before being placed in supine position, during the suspension there would be not only the hemorrhages named in No. 5, but also hemorrhages by hypostasis. 12. Whether in the hanging the hypostasis has already extended farther, this much is known, that it is found above the ligature and also below it at the lowest part of the body, or in general hypostasis is found posteriorly, and that it is more marked and extensive at the place of the knot than on the opposite side and below. 13. In hypostasis in hanging small hemorrhages only are possible because of the small quantity of blood in the head and the diminished pressure, and these only above the ligature, especially in the subcutaneous connective tissue and at the upper thyroid cornua. 14. From Nos. 5, 9, and 13 he holds as always and fully worthless the isolated hemorrhages just visible to the naked eye in the subcutaneous connective tissue anteriorly in the pale skin and in and between the anterior muscles of the neck, as well as the usual and also vital but slight hemorrhages at and around the fractures of the upper thyroid cornua; they may be considered of vital origin if the former are numerous, and the latter if twice as large as usual. 15. Besides the hemorrhages named in Nos. 5 and 13 hemorrhages also may occur in the supine position by gravitation if the body is taken down at a still later time. 16. The length of time within which these later hypostatic hemorrhages are possible is limited, not more than a few hours or a night. 17. If this interval, which may be too long or too short, is surpassed in hanging, then all hemorrhages except those of Nos. 5 and 13 may be considered as of vital origin. 18. A hemorrhage in the subcutaneous connective tissue, the entire breadth of the mark on the compressed skin, uninterrupted, limited by the mark, can arise only by removal of the pressure, therefore in the hanged after having been cut down, and only post mortem, and not in the resuscitated. Such a hemorrhage, if it also extends into the nearest vicinity of the mark, and only its connection with the mark is fixed, proves its post-mortem origin, not, however, at the same time with the mark. 19. The ligature fixes mechanically only a small part usually of the quantity of blood present under and close to the mark. A larger quantity of blood of the vital mark is essentially dependent on the larger blood contents of the vital skin as compared with the skin of the corpse. The blood flow to the vital mark during the hanging cannot explain the fixation of blood in the skin for the later investigation. 20. The differences therefore in the quantity of blood are not especially large and pass into one another.

---

[1] Vier. f. ger. Med., 1870, xii., pp. 340–369.

[2] *Ib.*, 1870, xiii., pp. 247–260.

[3] *Op. cit.*, p. 281.

[4] Vier. ger. Med., 1896, v., pp. 98 and 211, and vi., p. 44.

Macroscopically and microscopically the absolute quantity of blood in the vital mark is never so great that a diagnostic value is possible. 21. The following speak for a vital origin of the mark, although not surely proving it: (*a*) Larger and branched vessels filled with black red mass, visible to the naked eye, anteriorly, in the pale skin, going from below upward through the skin, in a double mark coursing into the interval; and (*b*), macroscopically, already visible filling of numerous superficial vessels of the smallest size, at the margin of the mark, anteriorly in the pale skin, which shows microscopically the uppermost cutis and papillary vessels filled with thick red homogeneous blood mass. Both conditions may be found, and earlier in skin which is already hypostatically pale. 22. Free blood in the tissue in and at the mark of the ligature, microscopical hemorrhages, are of mechanical nature, occur both ante and post mortem, and are worthless for diagnosis. 23. The above is true for both the single and double ligature so far as the latter acts as a broader, simpler one upon the underlying tissue. 24. For the intervening tissue between the double marks we have the following: The double ligature presses blood and tissue fluids into the intervening space; all appearances there are of purely mechanical nature. Only the quantity of blood therein, and equally whether free or in vessels, can serve a diagnostic purpose. 25. A more reddened, narrower intervening space from cords lying close together is also, in thoroughly blanched skin, valueless for diagnosis. 26. A redder, broader space is, in hypostatic skin, worthless. In paler skin it may speak for a vital origin if the redness has been shown to be dependent on the vascularity of the space. It must be estimated the more carefully the narrower it is; therefore the more the ligatures act on it as on a fine space, and the less it is extended forward over the anterior limits of the general hypostasis. 27. A more reddened, especially broader intervening streak, which arches forward wall-like during the pressure of the ligature, after removal of which rather overtops the marks, but lies more like a band of skin between the marks, speaks for a vital origin not only in the paler but also yet earlier in the hypostatically pale skin, if microscopically the entire tissue of the skin of the streak, cutis and fat layers, shows strong vascularity. Such a space can surely prove alone of vital origin if we can exclude a vital cyanosis of head and neck from death caused in some other way. 28. An œdematous appearance of the intervening space, macroscopic and microscopic vesicles on the same, in the marks also on the outside but close to a mark, are of mechanical nature, may arise post mortem, and are therefore worthless for diagnosis. 29. None of the conditions named, except No. 27 in rare cases, alone proves surely a vital origin. The opinion will always be, must be, formulated, that the exact examination of the mark supports the acceptance of vital origin, or makes vital strangulation more or less probable. The probability will increase and can, so far as is generally possible medico-legally, become a certainty, if it is supported by other circumstances, or several of the foregoing mentioned conditions coincide. 30. That vital signs at the mark are found only in certain cases and not very often, vital marks giving for the most part fully a negative condition, we should not on such a negative condition ever give an opinion that would mislead to an acceptance of post-mortem strangulation; but it should here also always be stated that the condition at the mark does not correspond to vital origin.

The NECK nearly always appears stretched. According to Roth the mobility of the head is increased by this stretching. The HEAD is always inclined to the opposite side to that of the knot. In suicides the head is usually bent forward on the chest. The HANDS are often clinched so tightly that the nails are driven into the palms. This occurs more especially when the hanging has been done with violence. When the feet touch the ground, as often occurs in suicide, the hands may be stretched out. Roth found the hands and feet flexed in 44 of 49 cases. Taylor says that we may expect to find the hands clinched when constriction of the neck is sudden and violent. The LEGS are usually livid.

The FACE varies with the duration of the suspension; at first it is pale, afterward livid; congested and swollen, if the subject has been long suspended. Roth found the face pale in 43 of 49 cases. In about one-half the cases the features are calm and placid (syncope). Maschka found the lips bluish in 98 of 153 cases. The EYES are often prominent, staring, and congested, and usually the pupils are dilated. Lacassagne and Maschka[1] look upon ecchymoses of the eyelids and conjunctivæ, "*piqueté scarlatin*," as important as favoring the idea of hanging or strangulation. Roth found in 49 cases the eyelids closed 28 times; half open, 12; congested in 6; ecchymosed in 2. Pupils dilated in 31; narrowed in 2. Dilated in 97½ per cent of Ogston's cases (Cases 85, 86; rupture of crystalline lens). Harvey[1] says the blood was found flowing from the EAR in 6 cases of nearly 1,500, but no details were given. Ogston, one case. Hofmann saw a case in which there was bleeding from the ears. He says this is not due, as has been supposed, to rupture of the tympanic membrane, but to hemorrhage from subcutaneous vessels (Case 27). Lannois[2] reports a case of rupture of tympanum in a man aged 61, who suicided by hanging; he quotes authorities and discusses the subject. Some writers consider the lesion to be *post mortem*. It is probable that the ear is but rarely examined. The cause of rupture seems still in doubt.

---

[1] Pellier, *op. cit.*, p. 83.

The TONGUE is usually livid and swollen, especially at the base. According to Tidy, Dr. Guy looks on this as showing that suspension took place very probably during life. In about one-third of the cases the tongue is protruded and compressed between the teeth; sometimes bitten. Some observers found it protruded only as a result of putrefaction. The protrusion of the tongue is not believed to depend on the position of the ligature. Hackel in 67 cases found the tongue lying forward in all cases where the cord was between the larynx and the hyoid; in 55 per cent in front of the teeth, in 18 per cent between the teeth; where the ligature was lower down, the tongue was behind the teeth. He found by experiment that in the spasmodic expiratory effort the tongue was thrust forward; in the inspiratory movement, drawn backward. He concluded that the forward movement was the result of reflex action. Maschka[3] found the tongue between the teeth 58 times in 149 cases. Roth in 49 cases found the tongue projecting and bitten in 22, the teeth shut in 15 others; in 15 the mouth was open; the tongue was retracted in 30 cases.

Harvey, after examining reports of nearly fifteen hundred hangings, says: "In the majority of instances immediately after death the features were placid, the face pale, the eyes not unduly prominent, the mouth closed or half open, the tongue pressed against the teeth but not protruding; the superficial veins full, but the head, neck, and trunk free from lividity. After a longer or shorter time, however, and apparently after a very few hours, in India, all this is changed. Livid patches appear about the chest, back, and shoulders; the face and head become bloated and puffy, the tongue and eyes protrude."

---

[1] Ind. Med. Gaz., 1876, xi., p. 30.

[2] Archiv. anthrop. crim., 1896, xi., p. 47.

[3] "Handbuch," p. 571.

Bloody froth is sometimes seen at the nose and mouth.

SALIVA is invariably secreted and runs out of the mouth down on the chin and chest. Its presence is considered as evidence that suspension occurred during life. The URINE and FÆCES are sometimes found to have been expelled. These discharges occur in all kinds of violent death. Tardieu found them, however, but twice in 41 cases of hanging. Roth in 49 cases found discharges of fæces in 17 and urine in 4; in 15 cases not noticed.

Harvey mentions a case where internal piles had burst, and there were stains and clots of blood about the perineum and anus. In such cases without careful examination there would naturally be a suspicion of violence.

In about one-fourth of the cases the GENITAL ORGANS are congested. The penis is large and more or less erect; seminal fluid, generally prostatic, and sometimes mixed with blood, is often expelled. The fluid may pass only into the urethra and it may be necessary to press the urethra to secure it. The clitoris may be found erect, and there may be a sort of menstrual flow. Orfila showed by experiment that swelling of the sexual organs and emission of semen can be produced after death in those who had been suspended during life. The flow of semen is found in all kinds of death by violence. Roth in 39 cases of hanging of men found the penis enlarged 18 times and ejaculation in 19. Hackel found the penis swollen in 43 per cent of cases of asphyxia. Erection may come on soon or late, even days after death.

Internal Appearances.—The CONNECTIVE TISSUE UNDER THE MARK is usually white and condensed, the more so if the body has been long suspended. This dryness or condensation was found by Hackel in 52 per cent of hangings. Deeper-seated parts are injured only when the hanging has been violently done. The MUSCLES, especially the sterno-mastoid, are sometimes ruptured. Hofmann[1] reports several cases. Lesser[2] in 50 hangings saw 11 ruptures of muscle. Maschka never saw the rupture in suicides. The sterno-mastoid was ruptured in the case of Wirtz (Case 96) and Guiteau (Case 95). Hackel in 67 cases failed to find the muscle ruptured. Hofmann[3] believes that the rupture of the muscle is sometimes post mortem. Coutagne[4] found the sterno-mastoid muscle ruptured once in 24 cases (Cases 29, 89, 95, 96).

The LARYNX may be fractured or dislocated. These lesions are very rare in suicide; more frequent in homicide and judicial hanging, and in the old where the cartilages are calcareous. Remer found the injury in but 1 case in 101 of suicidal hanging. Barker found the larynx *lacerated* in his judicial cases.[5] Harvey says that the TRACHEA was reported lacerated 11 times in nearly 1,500 cases; twice the laryngeal cartilages were separated from each other. In 5 these cartilages were fractured, but there was nothing to show under what conditions. Hemorrhage in vicinity of larynx, 43 times. Pellier[6] reports 1 case, and adds that the existence of the lesion easily escapes notice because of the mobility of the cornua. Roth in 49 cases failed to find any fracture. Pellier found the cricoid was injured oftener than the thyroid, which is the reverse of what is found in strangulation. Cavasse[7] was unable to cause fracture of larynx by hanging the cadaver. Chailloux[8] collected 6 cases of fracture of larynx in hanging. He concluded that the fracture could not be produced on the cadaver by hanging, and is, therefore, caused during life. Coutagne[9] in 24 cases found fracture of thyroid cartilage 8 times (Cases 9, 51, 82).

The HYOID BONE is rarely dislocated. Orfila mentions a case of fracture. Barker found the bone usually fractured in judicial cases. In the case of Wirtz (*supra*) the greater cornu was broken. Pellier reports 2 cases. Hofmann[10] says the hyoid cornua are often fractured, especially when the ligature is between the hyoid bone and thyroid cartilage. Coutagne

[1] Wien. med. Presse, 1881–1882, xxii., p. 1533.

[2] Vier. f. ger. Med., 1881, xxxv., p. 201.

[3] Lehrbuch, p. 532.

[4] *Op. cit.*, p. 245.

[5] See Brit. and For. Med. Rev., ii., p. 214.

[6] *Op. cit.*, p. 98.

[7] Paris thesis, 1859, No. 9.

[8] Paris thesis, 1874, No. 291.

[9] *Op. cit.*, p. 245.

[10] *Op. cit.*, p. 533.

found fracture of hyoid bone 8 times in 24 cases. He attributed the fracture to pressure against the spine. Pellier speaks of **fracture of STYLOID PROCESS (Cases 51, 84,** 88, 89, 95, 96).

Dr. Barker, of Melbourne,[1] states that in 50 cases of hanging by the old method there was not one case of *fracture or dislocation of vertebræ.* After adopting his suggestion to place the knot near the spine, he found that dislocation occurred between the second and third cervical vertebræ with fracture of the third and pressure on the spinal cord. Death was sudden and complete. The drop in these cases was short, three to four feet. Coutagne thinks that the ordinary mobility of the head, axis, and atlas on each other have led reporters into the mistake of supposing a dislocation of vertebræ. Roth failed to find fracture of vertebræ in any of 49 cases. These injuries are especially rare in suicide; but in violent hanging, dislocation or fracture may occur and also rupture of the ligaments. Harvey gives 5 cases of dislocation of vertebra and 4 of fracture of vertebra in suicides. Three of the latter were doubtful. Tardieu says these fractures have no significance as to the hanging having occurred during life. They can be produced on the cadaver; but infiltration of clotted blood around injured vertebræ shows that suspension occurred during life (Cases 5, 7, 8, 68, 76 to 79, 83, 84, 91, 92, 94).[2]

The CAROTID ARTERIES may be injured; usually the inner and middle coats are torn; and hemorrhage may occur into the wall of the vessel. The common carotids are the ones usually affected, and just below the bifurcation, but the external is also occasionally injured. The injury is said to be due to the stretching and squeezing of the artery, stretching being the most effective since the rupture often occurs at a distance from the mark of the ligature. Such injury of the artery does not prove that hanging took place during life because it has been produced on the cadaver; but hemorrhage into the wall of the vessel or wound or rupture after death is very improbable. Maschka says the lesion is very rare. Tardieu says that the injury to the carotid is rare and therefore unimportant. Pellier reports 4 cases of rupture of carotid in a total of 23. Levy records the experiments of Hofmann, of Vienna, and Brouardel and himself, of Paris, 5 in number. He concluded that compression of the carotid arteries, if it produces obliteration, can cause rapid loss of consciousness and death; and explains why in incomplete suicide the subject is unable to help himself. Coutagne found rupture of carotids 10 times in 24 cases. He insists on the importance of the lesion. Peham[1] reports 15 cases of rupture of carotid in hanging, out of 786 cases recorded in the Wien Forensic Institute; 11 of common carotid, 2 each of external and internal. The intima alone was affected.

---

[1] Med. Times and Gaz., 1871, i., p. 671.

[2] Lyon Méd., 1883, xliv., p. 11.

Hofmann says the rupture is always transverse, may be simple or multiple and may occur in suicides; more apt to occur when the ligature is thin. Lesser tabulated 50 fatal cases of suicidal hanging; in 29, he was satisfied that the hanging occurred during life. In 3 of these the skin of the neck alone showed any lesion; there was a double mark, the skin being otherwise bloodless. In 5 the deeper soft parts were the only ones affected. In 3 the skin showed lesions, the deeper soft parts none, but either the hyoid bone, larynx, or vertebræ were involved. In 12 the skin showed no mark, but the deeper soft parts and either the larynx or hyoid bone were involved; and in 6 the hyoid bone only or the bone and larynx were injured. In the remaining cases it was not possible to say that the hanging occurred during life. In 2 cases there were no marks at all; in 9 there were changes in the skin; in 4, changes in the skin and deeper parts; in 2, changes in the skin, deeper parts, and hyoid bone or larynx; in 3, changes in the skin and hyoid bone or larynx, or both. In 14 of the 50 cases the hyoid bone was fractured; in 20 the larynx; and in 1 the vertebræ. The common carotid arteries were injured in 6. The number and severity of the lesions bore no constant relation to the thickness of the ligature, nor to the force used, but rather to the position of the body.

Ecker[4] reported a case of suicidal hanging in a man, age 40, where the soft palate was swollen and filled up the passage so that the air evidently could not enter.

The LARYNX and the TRACHEA are usually deeply congested, of a red color; a violet color indicates putrefaction. Ogston reports mucus but not bloody froth 9 times in the pharynx, 6 in the trachea, and 4 in the lungs, in a total of 40 cases. In one case there was a quantity of blood in the larynx and pharynx. Taylor thinks that pinkish froth in the trachea indicates incomplete obstruction; and Chevers that it is due to spasmodic efforts to breathe when the obstruction is nearly complete. Chevers always found clear mucus in the larynx and upper part of trachea, each follicle being marked by a minute globule of mucus. Harvey states that this was noted a few times in his reports. Baraban[1] discusses the condition of the epithelium of the air passages in hanging.

---

[1] Vier. ger. Med., 1894, viii., supp. Heft, p. 176.

[2] "Lehrbuch," p. 535.

[3] Vier. f. ger. Med. und öff. San., 1881, xxxv., pp. 201–248.

[4] Virchow's Archiv, 1870, xlix., p. 290.

The condition of the lungs and heart varies according to whether death is due to syncope or asphyxia. Ogston found, in 22 cases, the lungs were expanded in 4 and collapsed in 2.

Harvey says the LUNGS are congested in over seven-eighths of the cases; emphysematous in a few; and subpleural ecchymoses present in a few. Patenko[2] experimented on dogs by hanging them. When the constriction occurred after expiration the lungs were congested; when after inspiration, not congested. In the first case (p. 223) the blood flows from the periphery to the heart and thence to the lungs, but cannot flow from the lungs because of the difficult circulation in the dilated pulmonary vessels and deficiency of intrathoracic pressure. There is in both cases cerebral congestion in the region of the bulb. Tardieu holds that punctiform ecchymoses and apoplexies do not occur in hanging unless suffocation has preceded. Pellier,[3] however, found these ecchymoses 14 times in 22 cases. He says that the lesion is not characteristic of suffocation, and quotes Lacassagne, Grosclaude, Dechoudans, Vicq, Chassaing, and Legroux to the same purpose. Hofmann[4] says that the ecchymoses are relatively rare in adults. Maschka[5] found them 18 times in 153 cases.

Harvey states that the presence of serum in the PERICARDIUM seems more a matter of time elapsed after death than anything else. Still the fact is that it is found much oftener in strangulation than in hanging. The difference is explained by the comparative slowness of death in strangulation. Harvey finds that in about one-half of the cases, if the body is fresh, the right side of the HEART, pulmonary artery, and venæ cavæ are full of dark fluid blood, the lungs being also much congested, and the signs of death by asphyxia well marked. When blood is found in both sides of the heart, it is probable that death is due to neuro-paralysis. When decomposition is advanced all the cavities are often empty. Taylor says that if the examination is delayed for several days, the distention may not be observed.

---

[1] Rev. Méd. de l'Est, 1890, xxii., pp. 545–554.

[2] Ann. d'Hyg., 1885, xiii., pp. 209–228.

[3] *Op. cit.*, p. 105.

[4] Lehrbuch, p. 537.

[5] *Op. cit.*, p. 607.

The STOMACH is often much congested, and this fact might sometimes suggest the possibility of poisoning. The LIVER, SPLEEN, and KIDNEYS are usually much congested. Hofmann[1] says that this occurs in the kidney only when the body has been hung a long time.

The BRAIN is rarely much congested. In 101 cases Remer found hemorrhage but once; and in 106 cases Casper failed to find it. Tardieu[2] says the brain is oftenest anæmic. If, however, the body is cut down and placed horizontally, the blood-vessels of the brain may fill up. Evidence may be found in the brain suggesting insanity and therefore an explanation of a probable suicide. Harvey says that hemorrhages in or about the brain are found in a much larger proportion of cases in India than in Europe in cases of hanging. "No common condition likely to cause extravasation is apparent, only one man being noted as plethoric, but in many the rope seems to have been very tight." Champouillon[3] reports a case of suicide in a man, age fifty-two; the rope broke and the body fell. The physician who made the necroscopy reported a rupture of the *pons Varolii*. Champouillon believed that the rupture must have been made in removing the brain from the skull. Wilkie[4] reports a judicial hanging in which a man age about twenty-five, fell about three and one-half feet. A recent clot was found in the brain. The experiments of Brouardel of hanging rabbits showed the brain anæmic.

The conjunction of the following appearances would suggest that the hanging had been of some duration: lividity of face, congestion and prominence of eyes, dryness of skin under the ligature, deep furrow, congestion of sexual organs, swelling and lividity of lower limbs, hypostatic congestion of lungs.

Page experimented on a young cat and young dog; both were hung in the same way. Examination of the cat showed the veins generally engorged; sublingual veins much engorged; tongue protruded slightly and much swollen; no frothy mucus in bronchi. In the dog the tongue did not protrude and was not swollen; right cavities of heart contained blood, left empty; brain and other organs normal. In the cat, the lungs were uniformly congested, dark red; no ecchymoses.

---

[1] *Op. cit.*, p. 597.

[2] *Op. cit.*, pp. 44, 54.

[3] Bull. Soc. Méd. Lég., Paris, 1875–76, iv., p. 373.

[4] Indian Med. Gaz., 1881, xvi., p. 275.

In the dog, the lungs were much distended, posterior borders mottled violet; emphysematous patches on surface; no apoplectic effusions; subpleural ecchymoses bright red, irregular, clearly defined in outer surface, most numerous toward the roots and on the lower lobes.

Pellereau[1] gives an account of hanging as seen by him in warm climates. He had not seen the elongation of the neck described nor the erection of the penis, nor subconjunctival ecchymoses, nor fracture of larynx, nor rupture of walls of carotid artery, nor subpleural ecchymoses, nor fracture of vertebra. He always found a mark on the neck; the left cavities of the heart always empty, the right always full of black blood. Mackenzie says that in 130 cases of suicidal hanging, the protrusion of the tongue between the teeth, the open and protruding eyes, clinched hands, and blue nails were very frequent, the tongue was found bitten many times, there were urethral and rectal discharges and rupture of carotid artery. The penis was found erect several times. The hyoid bone fractured 24 times in 93 cases. In no case was the larynx or vertebra fractured. In 73 cases ropes were used; in 30, portions of clothing. The marks of ropes were always well defined, indented, and parchment-like; the marks of soft ligatures faint and reddish. In no case were the muscles of the neck, the larynx, trachea, or large bronchi injured, and in none was there subcutaneous hemorrhage or blister.

PROOF OF DEATH BY HANGING.

As in strangulation, no single sign in any given case is sufficient of itself to prove that death was caused by hanging. But the sum total of the lesions found, viewed in the light of the surroundings of the body, will suffice to lead to a definite conclusion.

The fact that a body has been found suspended does not of itself prove that hanging caused the death, because the victim may have been killed in some other way, and the body afterward hung up to avert suspicion. Chevers records many cases of this kind.

The value of the presence or absence of marks on the neck and the characters of the marks has been questioned. Orfila, Casper, and Vrolik have shown by experiment that if a body is hanged within one or two hours after death the furrow, parchment skin, lividity, and the density of the connective tissue will appear just as is seen when suspension has occurred during life; but ecchymoses and infiltration, clotted blood in the skin, connective tissue, and muscles of the neck suggest suspension during life.

---

[1] Ann. d'Hyg., 1886, xvi., pp. 108–125.

If a cord is removed *immediately* after death, there may be scarcely any mark at all.

Tardieu collected 261 cases of suicide by hanging where the subject was not entirely off the ground. In 168 the feet rested on the ground; in 42 the subject was kneeling; in 29 lying down; in 19 sitting, and 3 were huddled up or squatting. Fatal hanging may, therefore, occur in almost any position of body. He shows incomplete hangings by thirteen plates. Taylor also collected reports of 11 cases in a few years; in 3 the subjects were nearly recumbent; in 4, in a kneeling position; in 4, sitting. Remer in 101 cases of suicidal hanging found in 14 that the body was either standing or kneeling; in 1, sitting. Duchesne published 58 cases of partial suspension, 26 of which were new. Some of these failures of complete suspension were due to soft and elastic cords.[1]

Taylor says that "that which is difficult to a conscientious medical jurist in confining himself to the medical facts is often easily decided by a jury from these as well as the general evidence afforded to them."

The limbs may be secured by the suicide before hanging himself. Persons even with some disability of the hand have suicided by hanging. Blindness is no obstacle, nor age; a boy as young as nine and a man as old as ninety-seven.

Burger[2] fully discusses the question whether the hanging is before or after death.

HANGING—SUICIDAL, HOMICIDAL, OR ACCIDENTAL?

Hanging is usually **suicidal.** Lesser[3] states that for three years, 1876–79, there were admitted to the Berlin morgue 274 bodies of "hanged," of which 272 were suicidal; 2 infants of three and eighteen months, homicidal. One man had first tried to kill himself with sulphate of copper; another by cutting his throat; a woman by cutting her arm. The other cases were uncomplicated. Pellier states that the number of suicides in France from 1876–1880 was 13,445, and nearly all were by hanging. Taylor[1] states that 2,570 persons committed suicide by hanging in England in five years, 1863–67; four-fifths of these were males. Harvey[2] reports for three years 1,412 cases of hanging in India, of which 2 were accidental, in 3 there was presumption of homicide, the rest probably all suicidal.

---

[1] "Med. Jur.," Am. ed., 1892, p. 408.

[2] Freidreich's Bl. f. ger. Med., 1890, xxi., pp. 149–171.

[3] Vier. f. ger. Med., etc., 1880, xxxii., p. 232, foot-note.

Feebleness of body does not preclude subjects taking their lives in this way. They sometimes also wound or poison themselves first and hang themselves afterward. A subject being found suspended in a room fastened on the inside, would be suggestive of suicide. The absence of signs of struggling or of any marks of injury also favors the idea of suicide.

The possibility of a suicide breaking a rope, being injured by the fall, and rehanging himself successfully, must be admitted (Cases 57, 58). The possibility of blood flowing after death must not be forgotten.

It is worthy of note that after beating or other violence children and women may commit suicide from shame. Again, as Tardieu says, many have hung themselves while partially intoxicated, and it is likely that some such have just previous to the suicide met with falls or other accidents which have left marks like those of violence. He also records the case of a woman who fastened a cord to a bed-post, put her head in a noose while kneeling on the bed, and made a deep wound in her arm with a razor. She closed the razor, laid it aside, and fainted from loss of blood. She must then have fallen forward and died from the pressure of the cord on her neck.[3]

Homicidal hanging is rare but does occur. Where the hands are tied together; where the injuries produced by the cord are severe; where there are contusions and well-marked ecchymoses; where the laryngeal cartilages and hyoid bone are fractured or the cervical vertebræ dislocated or fractured; or where the carotids are injured or there is hemorrhage into their walls; where there are severe wounds, the hemorrhage from which would be sufficient to threaten syncope; where there are many marks of violence on the body; where there is evidence of a severe struggle—in all these cases murder may be reasonably suspected. The number, situation, extent, and direction of injuries must be carefully noted and weighed. If these are out of proportion to the ligature, the suspension, etc., they strongly suggest homicide, although they may occur in suicide (see Cases 4, 11, 18, 20, 28, 29, 44, 52, 55, 59, 66).

---

[1] "Med. Jur.," Am. ed., 1880, p. 448.

[2] Indian Med. Gaz., 1876, xi., p. 3.

[3] *Op. cit.*, p. 132.

Homicidal hanging may be committed by an assailant who is strong on a subject who is weak, on a child, a woman, an old person; on one stupefied by liquor or narcotic poison; or by many combined against one person.

Cases are reported where injuries were inflicted or poison given, and the subject was afterward hanged to avert suspicion. Most of these cases are those of murder either by strangulation or suffocation (Cases 64, 65, 67, 68, 69, 70, 74).

Sometimes hanging is **accidental.** Children and even older persons play at hanging successfully. Taylor mentions the case of a boy who witnessed a hanging and afterward tried the experiment himself to ascertain the sensation, and caused his own death.

Tardieu[1] relates the case of a man, T., age 37, of small stature, feeble constitution, very thin, of sinister face, eyes hollow but lively, cunning nose and mouth, who meeting a man aged 81, learned that he had some trouble with his leg and promised to cure him. The old man lived alone. T. told him to buy a strong cord as thick as his little finger and one and one-half yards long, and keep the whole thing a secret. T. would see him at his room at 7 P.M. The old man became suspicious and had T. arrested. The investigation showed that already T. had made away with three old men by hanging, who were known to be opposed to suicide. Their bodies showed no trace of violence. Two others had escaped when the cord was passed around their necks.

Tardieu gives a number of cases of suicidal hanging which were falsely attributed to criminal violence, in which the pressure of public opinion joined to circumstances improperly explained by inexpert physicians caused deplorable judicial errors.

ILLUSTRATIVE CASES.

SUICIDE.

1. *Harvey: Indian Med. Gaz.*, 1876, *xi.*, *p.* 2.—Man, age 30. Found hanging by turban to bars of cell door; slip-knot around neck; heart beating feebly; died in about a minute after being cut down. "The point of suspension was forty-seven inches from the ground, the posi-

---

[1] *Op. cit.*, p. 66.

tion of the noose twenty-eight inches, and the feet were forty-two inches away from the door supported on the toes." Experiment showed that the turban could not have borne the full weight of the body. He died from strangulation.

2. *Ibid.*, *p.* 3.—Insane man, age 60. Put his neck in a V-shaped fork of a tree and let his body swing. A broad abrasion found on each side of neck. Scalp, brain, and membranes much congested; reddish serum in lateral ventricles; two ounces clear fluid in pericardium. Lungs congested; all the heart cavities contained blood.

3. *Ibid.*, *p.* 5.—Woman, age 28. Two marks of ligature on neck; one deep and circular passed up behind left ear; the other passed from the circular mark behind, crossed it on either side under lower jaw, thence up to chin. Appeared at first to be a case of strangulation following hanging; but the two marks were finally explained, that after the body was taken down it was ordered up again until the police should arrive.

4. *Ibid.*, *p.* 5.—Man, age 45; first cut his throat and then hung himself. "He had probably only just had time to hang himself before dying."

5. *Ibid.*, *p.* 30.—Woman; hung herself with a twisted cloth. There was much ecchymosis about the neck and upper part of chest; lungs much congested; fibrin clot in left mitral orifice; liver, spleen, and stomach congested; transverse ligament of atlas ruptured.

6. *Ibid.*—Man, age 39. Distinct mark of cord around neck; no other mark of violence; laceration of larynx and dislocation of odontoid process; hands clinched; involuntary discharge of semen; thoracic and abdominal organs normal.

7. *Ibid.*—Man, age 70. Mark of cord around the neck, superficial in front, deep behind; second cervical vertebra dislocated; tongue slightly protruding; fingers clinched; meningeal vessels engorged; lungs tubercular, congested; right heart contained a little coagulated blood.

8. *Ibid.*—Sex and age not given. Found hanging on a tree; usual signs; odontoid process fractured; rope in a double noose without knot, a common *dooree*, such as is used for drawing water.

9. *Ibid.*, *p.* 32.—Man, age 50. Face livid, eyes red and protruding; teeth clinched ; lower jaw retracted; tongue behind the teeth; hands and feet contracted; anus covered with fœcal matter; circular depressed mark of cord around neck, hard as parchment, slightly ecchymosed along edges; some infiltration of blood in connective tissue beneath the cord; some tearing of soft parts; laryngeal cartilage displaced. Brain and membranes congested. Right cavities of heart distended with dark blood. Trachea congested.

10. *Hurpy: Ann. d'Hygiène*, 1881, *vi.*, *pp.* 359–367, *with illustration.*—Woman, age 77, suicided by hanging in the following way: a

short cord was fastened by one end to a table leg; the other end was around her neck; she lay on the floor, face downward, clothing not disordered. The brain was congested; lungs congested and emphysematous; left side of heart empty (see Fig. 23).

11. *Champouillon: Same journal*, 1876, *xlvi.*, *p.* 129.—Man, age 62; first tried to suffocate himself with charcoal smoke and then hung himself, but the rope broke and the body fell. He lived two days.

12. *Pellier: Lyon thesis*, 1883, *No.* 188, *p.* 72.—Boy, age 16, hung himself; rope broke; he was resuscitated; reddish circular furrow on neck, not like parchment; he had erection and ejaculation; buzzing in his ears and flashes before his eyes.

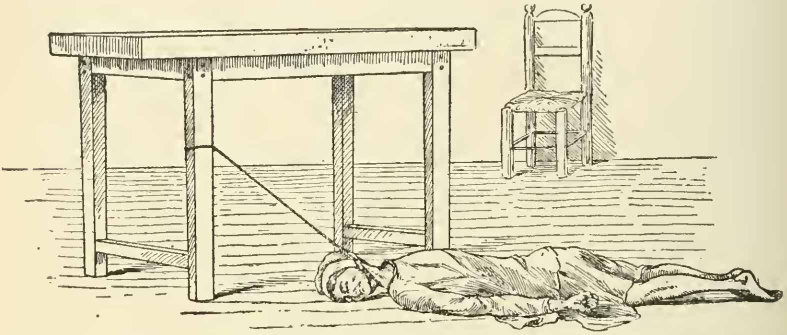


FIG. 23.—Suicide. The cord on the neck is 44 cent. from the cord on the table leg; vertex of head 30 cent. from table leg. Case reported by Hurpy (see p. 717, Case 10).

13. *Lacassagne: Pellier thesis* (*supra*), *p.* 71.—Man; hung himself; was cut down and sent to hospital; was aphonic for four days; then a severe bronchitis set in, and at the end of a week a gangrenous expectoration. The mark of the cord lasted fifteen days.

14. *Maschka: Archiv. de l'anthrop. crim.*, *Paris*, 1886, *i.*, *pp.* 351–356.—Man, age about 60, found dead under a tree in the woods near Prague. No sign of violence. A cord thick as a sugar-loaf around the neck; another cord attached to a branch of the tree. There was at first a strong suspicion of violence, but the conclusion reached was that he had hung himself and that the body had fallen from breaking of the cord; that death was due to asphyxia was shown by the furrow on the neck, the dark liquid blood, and the congested lungs. There was no infiltration below the furrow in the neck, and no lesion of larynx. The man had shown signs of melancholy.

15. *Friedberg: Virchow's Archiv*, 1878, *lxxiv.*, *p.* 401.—Suicidal hanging. Examination twenty-eight weeks after death. The front of the neck showed a groove above the larynx, firm and of gray color; ecchymosis in subcutaneous tissue.

16. *Bollinger: Friedreich's Blätt. f. ger. Med.*, 1889, *xl.*, *p.* 7.—Man, age 48; found dead. Had made a ligature out of a night-gown and tied it around his neck, the other end around top of a low bedpost; his neck hung by the ligature placed below the larynx. *Illustrated.*

17. *Med. Times and Gaz., London*, 1860, *ii.*, *p.* 39.—Woman; had collected accounts of celebrated persons who had been hanged; finally hanged herself.

18. *E. Hoffman: Mitt. d. Wien. Med. Doct. Colleg.*, 1878, *iv.*, *pp.* 97–112.—1st. Woman, age about 25; found dead sitting in bed, a handkerchief around her neck fastened to the bed-curtain. The police thought she had been killed and then hung, but the physician concluded that she had committed suicide. An examination of the stomach showed that she had previously tried to poison herself with arsenic.

19. 2d. Woman, age 51; found hanging in half-lying position.

20. 3d. Man, age 50. First tried to kill himself with phosphorus, then sulphuric acid; finally hung himself in a half-kneeling position.

21. *Müller-Beninga: Berlin. klin. Woch.*, 1877, *xiv.*, *p.* 481.—Man, age 40; hung himself. There was no swelling of genitals and no soiling of clothing. Necroscopy showed death from asphyxia, and in urethra near meatus quite a quantity of seminal fluid, as shown by microscopical examination.

22. *Tardieu: Op. cit.*, *p.* 18.—The Prince of Condé was found hanging in his room, August 27th, 1830. He was suspended by two handkerchiefs to a window fastening, his feet, however, touching the floor. The knot was at the back of the neck (as shown by the illustration), the face turned slightly to the left, the tongue protruding; face discolored; mucus at the mouth and nose; arms hanging and stiff; fists shut; heels raised; knees half bent. The text says that the knot was nearly under the right ear, but the illustration shows a different position (see Fig. 22, p. 743).

23. *Allison: Lancet*, 1869, *i.*, *p.* 636.—Three cases of suicide by hanging, in which there was no mark: 1st. Woman, hung herself with a piece of sheep-net band; cut down before death. 2d. Man, hung with plough-string; cut down in about six minutes. 3d. A heavy man.

24. *Tardieu: Op. cit.*, *pp.* 93–105.—Woman, died of coma and asphyxia from suicidal hanging, according to report of Drs. Costan and Facieu. Tardieu approved their report. It was at first thought a case of homicide with subsequent hanging, more especially because of the kind of knot used, *nœud d'artificier.* But Tardieu showed that it was also a *nœud de batalier.* Her feet touched a chair, and her knees were bent. There was a neckcloth in front of her mouth, but it did not seem to have interfered with respiration.

25. *Ibid., pp.* 67–72.—The famous case of Marc-Antoine Calas, who committed suicide by hanging (see Voltaire, "Traité sur le tolérance," etc., in *Nouv. Philos. Histor.*, 1772, xxxii., p. 30). He hung himself to a door. No sign of violence. The city hangman said it was impossible for a man to commit suicide in that way. The father was accused and convicted of homicide. Tardieu shows that the act was a suicide.

26. *Ibid., p.* 72.—Another famous case. A woman, age 30, hung herself to the key of her bedroom door. Her husband cut her down. He was accused and convicted of the crime and condemned to prison, where he died. Tardieu showed that the case was one of suicide.

27. *Hofmann: Wien. med. Presse*, 1880, *xxi., p.* 201.—Man, age 68, suicide by hanging. There was profuse hemorrhage from both ears.

28. *Ibid.:* 1878, *xix., pp.* 489–493.—Woman, found dead sitting in bed. She first tried to poison herself with arsenic, then hung herself.

29. *Ibid.*—Man, tried to poison himself with phosphorus and sulphuric acid, then hung himself. There was a transverse rupture of the sterno-cleido mastoid muscle and suffusion in its sheath.

30. *Maschka: Wien. med. Woch.*, 1880, *xxx., pp.* 714, 747, 1075.—Man, age 63. It was at first a question of suicide by hanging or homicide by strangling. He concluded that it was the former.

31. *Ibid.*—Also man, age 58. Similar case. Same opinion.

32. *Ibid.:* 1883, *xxxiii., pp.* 1118–1120.—Woman. age 23. Question whether she committed suicide by hanging or was strangled and then hung. Opinion, that it was a case of suicide.

33. *Hofmann: Allg. Wien. med. Zeit.*, 1870, *xv., pp.* 192–214.—Man, age 60. Suicide by hanging or homicide; opinion, that it was the former.

34. *Van Haumeder: Wien. med. Woch.*, 1882, *xxxii., pp.* 531–533.—Suicide by hanging or homicide. There were many wounds in the head; these occurred during the delirium of typhus.

35. *Maschka: "Sammlung gericht. Gutacht.," etc. (Prag), Leipzig*, 1873, *p.* 137.—Boy, age 9; found dead in sitting position. Injuries on neck and elsewhere. Question, had he hung himself or been choked? Were the injuries inflicted before or after death? Opinion, suicide.

36. *Ibid., p.* 144.—Boy, age 13. Found hanging in sitting position. Question whether murder, suicide, or accident. Opinion, suicide.

37. *Ibid., p.* 149.—Woman, age 60; found hanging, sitting position. Suicide or homicide. Opinion, suicide.

38. *Ibid., p.* 156.—Woman, age 30; found hanging. Opinion, suicide.

39. *Ibid., p.* 165.—Man, age 63. Suicide by hanging, or homicide by strangling? Opinion, suicide.

40. *Berliner: Viert. f. ger. Med. und öff. San.*, 1874, *xx.*, *pp.* 245–253.—Woman, age 30; found hanging. Opinion, suicide.

41. *Deininger: Friedreich's Blät. ger. Med.*, 1884, *xxxv.*, *pp.* 47–59.—Woman, age 61; found hanging. Opinion given, suicide.

42. *Mader: Bericht d. k. k. Rud. Stift., Wien.* (1875), 1876, *p.* 378.—Woman, age 43; tried to hang herself. She was at once cut down, bled, and taken to hospital unconscious. Next day, face red; pulse and temperature normal. Third day, conscious and could speak, but not aloud; tongue twisted and turned to right; paralysis of right hypoglossal nerve. Uvula drawn to left. Skin of right limb felt "furry." Applied electricity and gave strychnine; phonation was more distinct during the use of the battery. Two months later she was still aphonic, but the vocal cords were in better action. The right hemiparesis was lessened.

43. *Grant: Lancet*, 1889, *ii.*, *p.* 265.—Man, age 48; found sitting against a door, hung to the knob by a handkerchief.

44. *White: Lancet*, 1884, *ii.*, *p.* 401.—Woman, age 53, insane. Made several attempts at suicide; once with a stocking around her neck, once with an apron; the last time by fastening a portion of her dress to a ladder. She was quickly cut down, cold affusion applied, and artificial respiration (Sylvester). The eyes were prominent and glassy, pupils widely dilated, no reaction to light; conjunctivæ insensitive; lips livid; tongue swollen and pale; face pale; oblique depressed mark on neck, most marked on left side; skin cold; no pulse; no heart-beat recognizable; no respiration; no reflex action. Galvanism failed to arouse any muscular action. The details are too numerous to give all of them. There was reduplication of heart-sounds for several days, due to interference with pulmonary circulation. She recovered both bodily and mental health.

45. *Richards: Indian Med. Gaz.*, 1886, *xxi.*, *p.* 78.—Man, age 20; suicide; was cut down and lived for four days.

46. *Kite: Univ. Med. Mag.*, 1888–89, *i.*, *p.* 475.—Man, age 69; suicide.

47. *Terrier: Prog. Méd.*, 1887, *vi.*, *pp.* 211–214.—Two men, age 29 and 25, insane. Attempted suicide by hanging. Both resuscitated.

48. *Nobeling: Aertz. Intellig.-bl.*, 1884, *xxxi.*, *p.* 213.—Two suicides by hanging; men, ages 24 and 40.

49. *Ritter: Allg. Wien. med. Zeit.*, 1886, *xxxi.*, *p.* 375.—Soldier, found hanging. Cut down in ten minutes. Artificial respiration applied; fifteen minutes later, an effort at respiration; face changing from blue to white and then to red; pulse small, irregular; still unconscious; mark of ligature distinct; a few hours later had a maniacal seizure; gave morphia hypodermically and he slept; was also aphonic. Gradually recovered and returned to duty.

50. *Strassmann: Viert. f. ger. Med.*, 1888, *xlviii.*, *pp.* 379–381.—

Three cases of suicidal hanging in men, ages 27, 37, and 40. The last was found kneeling.

51. *Balta : Pest. Med. Chir. Presse*, 1892, *xxviii.*, *p.* 1244.—Man, age 45–50; hanging; suicide. Thyroid cartilage and hyoid bone broken.

52. *Hackel : Op. cit.*, *p.* 35.—Man, found hanging to a beam by a sheet. Had previously tried to choke himself with his hands.

53. *Ibid.*—Two cases of suicidal hanging where the cord made no mark. In the first the body hung free ; in the second the body was partly supported. In the first there was no rubbing of the skin; in the second the body was soon cut down.

54. *Freund : Wien. klin. Woch.*, 1893, *vi.*, *pp.* 118–121.—Man, found hanging ; cut down, but could not be resuscitated. Ligature between hyoid bone and larynx, then crossed over itself about middle line of neck, passed up along each side of face, knotted above the head, then thrown over a beam, and on the other side the loop was caught between his legs.

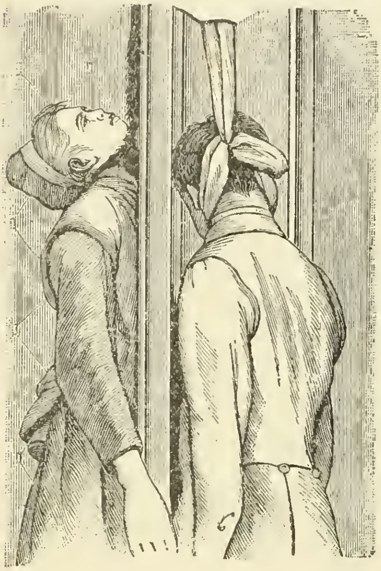


FIG. 24.—Double Suicide (see Case 55).

55. *Hoffman : Op. cit.*, *p.* 525, *illustrated.* — Case communicated by Dr. Rosen, of Odessa. Man, age 21, and woman, age 17, hung themselves by same ligature thrown over an open door, one of them on each side. They had previously tried other means of suicide without success (see Fig. 24).

56. *Ibid.*, *p.* 530.—Man found hanging by handkerchief to branch of tree but sitting on the ground. Mark of handkerchief superficial and pale. When the necroscopy was made the mark had disappeared. Also a similar suicide where there was no mark at all.

57. *Ibid.*, *p.* 541.—Man found hanging to a window. Another man cut the cord and the suspended one fell into a cellar, fracturing his skull.

58. *Ibid.*—Man found hanging ; cut down ; the fall caused rupture of liver.

59. *Ibid.*, *p.* 539.—Drunkard hung himself; there was evidence that he had previously injured himself during his drunkenness.

60. *Ibid.*—Boy hung himself because he had been punished by the

schoolmaster. There were marks on his back and lower limbs from the punishment.

See also Taylor, "Medical Jurisprudence," pp. 451–452; Tidy, "Medical Jurisprudence," *incomplete* hanging, Cases 33 to 36 and 62; Hofmann, "Lehrbuch," p. 538; also some more recent cases, namely: Freund[1] (this is accompanied by an excellent illustration); Templeman,[2] Reineboth,[3] in which tracheotomy had previously been performed; and Dufour.[4]

HOMICIDE.

61. *Harvey: Indian Med. Gaz.*, 1876, *xi.*, *p.* 3.—Woman, age 20, feeble. Her mother-in-law had kicked her; she probably had fainted; supposing her to be dead, the husband hanged her to a tree within half an hour after the supposed death. Autopsy: No marks of injury; oblique mark of cord on right side of neck; tip of tongue between the teeth; face somewhat livid; right side of heart full of dark blood; lungs congested posteriorly.

62. *Ibid.*, *p.* 4.—Woman, age 38. Rope close under the chin passed upward behind the ears. Head bent on chest. Large wound above clavicle. Under the rope was a depression (made after death) but no hemorrhage. Much blood in abdomen and a hole in the liver. Kidney bruised and blackened. Right lung torn through; blood in pleuræ. Wounds were supposed to be gunshot, but the husband confessed that he had thrust a sharp solid bamboo into her body and afterward hung it up. She died of hemorrhage.

63. *Rehm: Friedreich's Blät. f. ger. Med.*, 1883, *xxxiv.*, *pp.* 332–362.—Man, age 73; first roughly maltreated; afterward hung.

64. *Tardieu: Op. cit.*, *p.* 125.—Woman found hanging in her room. Circumstances indicated homicidal strangulation and that the hanging was done to avert suspicion. Post-mortem examination showed the base of the tongue ecchymosed, and ecchymosis extending up to the soft palate; mucous membrane of pharynx congested; connective tissue and mucous membrane between hyoid bone and larynx congested posteriorly; epiglottis showed slight ecchymosis, mucous membrane red. These ecchymoses were not caused by the cord, for the latter was placed below the hyoid bone and this bone was not broken. There were also marks on the collar-bone like the mark of two hands.

65. *Ibid.*, *p.* 124.—Girl, 15 years old. Body found hanging. Post mortem showed beyond doubt that she had been violated, then strangled, then hung. Her head showed many ecchymoses from either the fist or the foot; blood flowing from left ear. Brain slightly congested. Tongue between teeth, bitten and bloody. On front of neck were two marks: the lower were impressions of fingers close together,

---

[1] Wien. klin. Woch., 1893, vi., p. 118.

[2] Edinburgh Med. Jour., 1893, xxxix., i., p. 207.

[3] Vier. ger. Med., 1895, ix., p. 265.

[4] Ann. d'Hyg., 1897, xxxvii., p. 291.

nearly uninterrupted, and which had bruised, flattened, and tanned the skin, which here was dry, hard, and horny. This lesion was above the intraclavicular notch and extended toward the sides of the neck with regularity of curve and neatness of imprint, evidently made with the right hand. Above the first furrow under the skin was a kind of track, less extended, more regular, a bruising of the same nature as the preceding, but continued, due to the pressure of the index finger and thumb of left hand. A little below the jaw was a livid place on the skin, which was otherwise unaffected by the ligature. There was nothing to indicate a circular action of the ligature. Froth in larynx and bronchi. Lungs apparently normal. Food had passed from stomach into œsophagus and air-passages.

66. *Ibid.*, p. 122.—Woman found hanging in her room, and was resuscitated. She stated that the man who lived with her had tried to strangle her and then hung her. Tardieu saw her in hospital. Respiration short and embarrassed; pains in neck and jaw. Found narrow, circular, sinuous, horizontal, uninterrupted line around the neck below thyroid cartilage; line everywhere equal, deep, and three to four mm. wide; the skin excoriated and covered with thick crust. Below this were several superficial excoriations. There were many contusions on other parts of the body. Tardieu concluded that the mark on the neck was from attempt to strangle; the wounds elsewhere to prevent resistance. She had at the time pulmonary consumption. She died of this disease aggravated by the assault.

67. *Ibid.*, *p.* 106.—The Duroulle affair. Woman found hanging. Presumption of homicide; arrest of husband; acquitted. She was found with her face to the floor, one end of a cord around her neck; another similar cord attached seven feet above to a rafter, over which it passed three times. Bidault and Boulard reported it a suicide. The results of the post mortem were as follows: Skin of a red-violet color; face swollen; eyes prominent and congested; conjunctivæ a vinous red; lips violet; tongue swollen, tip between teeth; froth in air-passages; lungs congested; brain congested; blood fluid. Circular depression around neck with congestion of skin above and below; ecchymosis in subcutaneous tissue on level of angle of jaw and about one centimetre in size, supposed to correspond to the knot. Tardieu reported that the marks rather resembled those of strangulation than hanging; the ecchymoses were more like those produced by the hand over the mouth. The marks on the face supposed to have been made by a supposed fall of the body were by him considered to have been caused by violence. He believed the woman had been strangled and then hung.

68. *Ibid.*, p. 130.—The Daugats affair. Man found hanging, sitting on the ground, head and trunk somewhat inclined to the left; legs stretched out; clothing not disordered; the part of the cord which was around the neck was applied to the neck of the waistcoat and shirt; on

his head a woollen cap. The ground had been recently swept. Necroscopy twenty-four hours afterward. Face pale; right eye open and prominent, left closed; mouth closed, contained food apparently from the stomach; tongue retracted; slight mark on neck under which the tissue was normal; atlas dislocated on axis, but tissues around were normal; no lesion in spinal canal; penis not erect; moisture having the odor of urine on the shirt; large ecchymosis and infiltration of left cheek; extensive contusions on scrotum, with hemorrhagic infiltration, especially around right testicle. Veins of head engorged with black fluid blood. Brain normal. Some black fluid blood in right cavities of heart, left side empty. Lungs black. Other organs normal. Causse and Orfila concluded that the man had been suffocated and then hung. The wife and son confessed that they had injured the testicle through the pantaloons; he then fainted; they then suffocated him with the woollen cap placed over the mouth and nose; the son kneeled on the man's belly, the body was then hung up and the head violently twisted.

69. *Passauer: Viert. f. ger. Med. und öff. San.*, 1876, *xxiv.*, *pp.* 26–49.—Woman found hanging in a kneeling position. The ligature on the neck was loose. The necroscopy showed the following: Tongue between the teeth; eyelids swollen and livid; livid spots on face and left ear; lower lip torn; a number of marks on neck; one red stripe not sharply limited; skin not parchmenty and no ecchymosis; ecchymoses of scalp; periosteum of skull reddened; hemorrhage in temporal muscle; brain and pia mater congested; much fluid in ventricle. Larynx and trachea dirty red-brown; right side of heart empty; a little dark fluid blood in left; great vessels, including aorta, containing much dark fluid blood. Lungs congested and œdematous. Liver, spleen, and kidneys congested. Opinion given that she died of asphyxia and was either choked or hanged. Reference to Royal College of Medicine, Königsberg, where the opinion was given that she died of injuries on head and neck and was afterward hanged.

70. *Becker: Same journal*, 1877, *xxvii.*, *pp.* 463–473.—Woman, age 52; found hanging. Death caused by shock and incipient asphyxia from strangulation and probably the wounds on head and limbs.

71. *Maschka: "Samm. gericht. Gutacht.," etc. (Prag), Leipzig*, 1873, published a number of interesting cases, in each of which there was a question raised as to the cause of death.

72. *Ibid.*, *p.* 127.—Man found dead. Had he been strangled or hung, or had he died some other way? Opinion, death from paralysis of the brain.

73., *Ibid.*, *p.* 133.—Woman, age 42; found hanging; a mark around her neck. Did she hang herself or die of other injuries? Opinion, died of other injuries.

74. *Rehm: Friedreich's Blätt.*, 1883, *xxxiv.*, *pp.* 322–362.—Man, age 73; found hanging. Opinion, while weak, sick, and suffering from

wounds inflicted by his own son, he was hanged by his daughter-in-law.

75. *Hofmann:* "*Lehrbuch*," *p.* 538.—A father hung his five children, the eldest 9 years. Another man hung two children, the eldest 13 years.

See also Tidy, "Med. Juris.," Cases 40, 48, 51, 57 (?), 58 (?); "Hanging after Death," Case 50.

JUDICIAL HANGING.

76. *MacLaren: Indian Med. Gaz.*, 1873, *viii.*, *p.* 234.—Three cases of judicial hanging; hung at the same time and cut down and necroscopy begun forty minutes afterward; drop twelve inches. In the first and third there were reflex movements for a few minutes after drop fell. *First man*, age 40; pupils slightly dilated; no protrusion of tongue or eyeballs; mark of cord above thyroid cartilage; no discharge of semen or fæces; ecchymosis under cord, left side; dislocation of atlas from axis; odontoid ligaments ruptured; transverse ligament uninjured. Brain and membranes much congested; clear fluid in lateral ventricles. Lungs collapsed, anæmic; one ounce straw-colored serum (measured) in pericardium; dark fluid blood in both ventricles of heart; liver much congested.

77. *Second man*, age 16; pupils widely dilated; eyeballs protruding. Marks of cord same as in preceding case. No discharge of fæces or semen. No ecchymosis under cord; dislocation and rupture of ligaments between axis and third vertebra. Brain did not show well-marked congestion. Lungs collapsed and anæmic. One and one-quarter ounces serum (measured) in pericardium. Heart normal; dark blood in both ventricles; liver normal.

78. *Third man*, age 20; pupils slightly dilated; eyeballs and tongue not protruded. Marks of cord as in preceding. No discharge of fæces or semen. Slight ecchymosis under cord; mark in front of neck. Dislocation of occipital bone from atlas. Brain and membranes much congested. Lungs collapsed and anæmic. Half ounce serum in pericardium. Heart normal; dark fluid blood in both ventricles; liver normal.

79. *Cayley: Ibid.*, *p.* 122.—Man, age 35; executed by hanging. Scarcely any convulsive movements after drop fell. Necroscopy two hours afterward. No congestion or protrusion or swelling of the tongue; no muscular rigidity or contractions. About half-way around the neck was indentation of cord, obliquely directed; hardly perceptible in front; its surface appeared rubbed and compressed; no discoloration; no ecchymosis under skin. Cord lay across upper part of thyroid cartilage. Larynx and trachea not injured. Fracture and dislocation of upper cervical vertebræ. Lungs collapsed, not congested. Pericar-

dium empty; heart distended, left side with red blood just beginning to clot; right side with fluid black blood. Liver and other abdominal organs much congested. No discharge of fæces or semen.

80. *Garden: Same journal*, 1880, *xv.*, *p.* 12.—Man, age 40, weight about one hundred and twenty pounds; drop two feet; was in a fainting condition, and had to be supported; was not probably fully conscious when platform fell. There were spasmodic retractions of arms and legs for about two minutes; forty seconds after the drop his *jungeas* fell off; his penis was in strong erection, and the ejaculatory movements were seen. Necroscopy one and one-quarter hours after drop fell. Head and limbs cold; eyes open, natural; tongue not protruding; fingers clinched; superficial veins contained fluid black blood. Mark of cord extended from just below left mastoid process, where the knot was applied, across the thyro-hyoid membranes to a place on right side about two inches below ear. There was scarcely a trace of it behind. Skin dark and ecchymosed, but no ecchymosis of subcutaneous connective tissues. No discoloration nor fracture in neck. Subarachnoidal fluid in excess; puncta vasculosa unusually numerous. Under surface of epiglottis reddened and showed two small dark red ecchymoses; mucous membrane of larynx and trachea pale. Lungs showed venous congestion; no infarctions or small ecchymoses; right lung emphysematous; the left showed old firm adhesions throughout. Heart large, flabby, pale, a very little blood in each ventricle; subpericardial ecchymosis one-fourth inch square anteriorly, another larger one posteriorly; extensive pericardial adhesions. Liver and kidneys congested.

81. See two cases of judicial hanging by *Wilkie, same journal*, 1881, *xvi.*, *p.* 275.

82. *Porter: Archiv. Laryngol., New York*, 1880, *i.*, *p.* 142.—Redemier hung. Drop five feet. Pulse beat rapidly a few minutes, then lessened in frequency and stopped beating in fifteen minutes. During this time there was violent spasm of muscles of thorax and upper limbs. Necroscopy, dark groove around neck crossing larynx just below *pomum Adami.* Brain congested. Lungs emphysematous. Cricoid cartilage fractured diagonally. Laryngeal mucous membrane showed ecchymosis and œdema. Vertebræ neither fractured nor dislocated.

83. *Another* criminal hung at the same time had dislocation of cervical vertebræ.

84. *Fenwick: Canada Med. Jour.*, 1867, *iii.*, *p.* 195.—Man executed; drop six feet; second cervical vertebra torn from attachment to third; medulla torn across; hyoid bone and tongue torn from thyroid cartilage; general congestion of viscera; lenses normal; eyes congested; clot between sclerotic and choroid coats left eye.

85. *Dyer: Trans. Amer. Ophthal. Soc.*, 1866, *p.* 13.—Man, age 24; weight one hundred and seventy-four and a half pounds; drop three feet; knot under left ear; for two minutes at intervals, slight motion of abdomen, like effort at respiration, and at same time knees drawn

up a little. Death speedy and quiet. Cut down at end of thirty minutes. Necroscopy thirty-five minutes after drop. Body and head moist and warm; emission of semen; face livid; upper lid discolored; abrasion of skin under right ear; deep red mark around neck. Eyeballs not prominent; eyelids closed; corneæ dull; pupils a little dilated. *Both lenses fractured.* Brain normal; spinal cord normal. Heart empty.

86. *Dyer: Same Trans.*, 1869, *pp.* 72–75.—Man hung. One eye showed *fracture of lens*, the other lens showed fine lines. A second case showed dislocation of a cataractous lens. A third showed fissure of lens.

87. *Green: Same Trans.*, 1876, *p.* 354.—Man hung; drop seven or eight feet. Died quietly and without struggle. One-half to one hour after drop fell, eyes were examined. No lesion of capsule or lens.

88. *Keen: Amer. Jour. Med. Sci.*, 1870, *lix.*, *p.* 417.—Two criminals hung; drop five feet. Hyoid bone fractured in one; no fracture of vertebræ in other.

89. *Clark: Boston Med. and Surg. Jour.*, 1858, *lviii.*, *p.* 480.—Execution of Magee. Man, age 28; weight 130 pounds. Drop seven to eight feet. No struggle nor convulsion. Urine discharged at once. Seven minutes after drop fell, heart-beat one hundred; nine minutes, ninety-eight; twelve minutes, sixty and fainter; fourteen minutes, not audible; twenty-five minutes, body lowered. Face purple; pupils dilated; eyes and tongue did not protrude. Mark of cord just above thyroid cartilage, a deep oblique furrow except a small space under left ear; knot over mastoid process. Forty minutes, cord and strap removed; body, especially face, became paler. Necroscopy a little over an hour after drop fell. Body pale; skin mottled; small ecchymosis just above line of cord right side. Right sterno-mastoid muscle torn. Hyoid bone fractured; spine not injured. No seminal discharge. Ninety minutes, pulsation in right subclavian vein; heart-beat, eighty per minute; thorax opened, heart exposed; right auricle showed full and regular contractions and dilatations. The spinal cord was then divided. One hundred and twenty minutes, heart-beats forty per minute. These pulsations of right auricle continued at intervals for three and a half hours longer; readily excited by point of scalpel. Heart normal; left ventricle contracted; right ventricle not so; no coagulation. Brain normal; lungs collapsed; liver and spleen congested; mucous membrane of small intestine pinkish; other organs normal. In the discussion, Dr. Gay thought the absence of cerebral congestion was due to the circulation continuing in the left carotid.

90. *Hofmann: Wien. med. Woch.*, 1880, *xxx.*, *pp.* 477–480.—Man, a criminal, hung; after hanging ten minutes, the body was cut down. Examination half-hour after drop fell. He was resuscitated and partly regained consciousness, but died three days afterward of œdema of

lungs after repeated severe convulsions. He had tumors of the neck which probably interfered with the compression of the trachea. See also Allg. Wien. med. Zeit., 1880, xxv., p. 161, and Wien. med. Blät., 1880, i., pp. 423–430; translated in Ann. Mal. Oreill. and Larynx, Paris, 1880, vi., pp. 99–112.

91. *Kinkhead: Lancet*, 1885, *i., pp.* 657, 658, and 701–703.—Cases of hanging. In one, the body of the third cervical vertebra was broken across and the two pieces separated; in another case dislocation of second and third cervical vertebræ.

92. *Nelson: Southern Clinic*, 1885, *viii., pp.* 198–202.—Two colored men hung; drop five feet. In one there was atlo-axoid dislocation.

93. *Dercum: Phila. Med. Times*, 1886–87, *xvii., p.* 368.—Description of the brain of a man executed by hanging.

94. *Kirtikar: Trans. M. and P. Soc., Bombay*, 1885, *vi., pp.* 104–107.—Man, age 25, and woman, age 35. Both hanged. Drop nine feet. Knot tied over cricoid cartilage, a little to left side. In falling, the knots slipped to below the ear. There was fracture of the body of third cervical vertebra and rupture of ligaments. The cord was ruptured in each; in the woman in two places—once at the third cervical, the other at the dorso-lumbar junction.

95. *Lamb: Med. News, Philadelphia*, 1882, *xli., pp.* 42–45.—Execution of Guiteau. Drop six feet; knot placed under left ear, but slipped to back of head. Yellowish furrow a few lines wide around the neck, directed downward and forward. Sterno-mastoid muscles torn transversely about midway of their length. Thyro-hyoid ligament ruptured; hyoid bone and thyroid cartilage widely separated. Large blood-vessels not injured. No fracture or dislocation of vertebræ.

96. *Thomson and Allen: Catalog. Surg. Sec. Army Med. Mus.;* specimens 298 to 302.—Execution of Wirtz. Rope one-half inch diameter; drop five feet; knot under left ear. Several slight shrugs of shoulders, after which body was quiet; let down in fifteen minutes. No involuntary evacuation. Face pale, placid. Eyes partly open; pupils dilated; slight injection of conjunctivæ. Mouth open; tongue not protruding. Just above thyroid cartilage extending on right side from median line in front to spinous process was a dirty brown deep furrow with congested walls; on left side a line of discoloration due to direct action of rope. Soft parts above and below the line much swollen, particularly on right side. Larynx and hyoid bone unnaturally mobile. Right trapezius muscle torn; sterno-mastoid divided transversely, leaving an interval of two inches. Slight ecchymoses between muscle and larynx. Ecchymoses on *ligamentum nuchæ.* Hyoid bone, both greater cornua fractured and dislocated from body; lesions more marked on right side. Several small ecchymoses in vicinity. Larynx not injured. Brain normal. No bloody or frothy mucus in

air-passages. Lungs not congested. One drachm of straw-colored serum in pericardium. Heart empty. Abdominal organs normal. Bladder somewhat distended with urine.

See also Tidy, "Med. Juris.," Cases 1 to 4 and 60.

ACCIDENT.

97. *Harvey: Indian Med. Gaz.*, 1876, *xi.*, *p.* 3.—Boy, age 1½ years; was swinging by two ropes attached to two posts; the ropes became twisted around his neck. Necroscopy showed mark of very small rope in front of neck from ear to ear; mucous membrane of larynx dark; lungs much congested.

98. *Hackel: Op. cit.*, *p.* 35.—Man, age 19, sitting on a load of wood, with the lines around his neck, fell and was hung by the lines.

99. *Biggs and Jenkins: New York Med. Jour.*, 1890, *lii.*, *p.* 30. —Case 16; child, 6 months old, sitting on a high chair, fell between the chair guard and seat and was asphyxiated by compression of neck.

See also Tidy (*op. cit.*), Cases 53 and 54.

SUFFOCATION.

The term suffocation is applied in a special sense to the act and condition of preventing access of air in other ways than by pressure on the neck, as by pressure on the chest, by obstruction at the mouth or nose, by obstruction in the air-passages or on them from neighboring organs, by irrespirable gases, etc.

This article will consider all of these except drowning and irrespirable gases, which are treated of elsewhere by other writers.

Smothering is generally understood to mean the act and effect of stopping the mouth and nose.

CAUSES.

External Causes.—OVERLAYING is a frequent cause of suffocation in infants, which in such cases have usually occupied the same bed with one or both parents. In some cases the parents have been drunk or otherwise unable to prevent the injury, and the infant may also be partly stupefied with the alcohol derived from its mother's milk. Infants are also sometimes overlaid by domestic animals. Again, they have been suffocated by being pressed too closely to the mother's breast, or by covering with bedclothes, shawls, etc. Noble[1] attributes some cases of asphyxia in the new-born to anæmia of the brain from pressure on the skull by forceps, etc., and recommends as treatment for this condition hanging the child, head downward, so that the blood may gravitate to the brain (Cases 12 and 30).

Infants are sometimes smothered for mercenary purposes.

Persons have been suffocated by the pressure of a crowd. Pressure on the chest combined with forcible closure of the mouth and nose was the method of Burke and Williams, in the notorious *burking* murders (Case 58). The close application of a hand, cloth, or plaster over nose and mouth is of itself sufficient to cause suffocation, especially in children and feeble persons. Pressure on the abdomen crowds up the diaphragm and interferes with breathing. It is very likely that no external mark will be found in cases of pressure on the chest and abdomen, but the lungs will be marbled and emphysematous.

Taking plaster casts of the face and neck without inserting tubes in the nostrils has caused death in some cases. Suffocation often follows the falling of walls, houses, banks of earth, piles of coal or corn or wheat. One may fall into and be imbedded in some mobile substance as coal, wheat, corn, quicksand, or nightsoil, and be suffocated. Infants have been destroyed[2] by burying them in manure, ashes, bran, etc. In these cases there is not only the entrance of the foreign body into the air-passages, but the pressure of the mass against the chest and abdomen.

Internal Causes.—The air-passages may be closed up by foreign bodies within them, or within adjoining organs, especially the œsophagus. A great variety of substances in one of these two ways has caused suffocation: mud, cotton, rags, corn, meat, beans, pepper, potato skins, the fang of a tooth, artificial teeth, buckles, shells, flint, buttons, screws, crusts of bread, bones, fruit, stones, heads of grass, coins, slate pencils, nuts, nut-shells, shot, penholders, worms, fish, etc. (see Cases 6 and 55). Taylor[3] states that there were eighty-one deaths in one year in England and Wales from food in the air-passages.

Should an inspiration occur in the act of vomiting, the vomitus may pass into the air-passages; a similar accident may occur in a person who attempts to swallow and speak at the same time. Infants have been suffocated by inspiring vomited milk. Fitz[1] states that food may pass from the digestive tube to the air-passages after death.

---

[1] Amer. Jour. Obstet., 1886, xix., pp. 349–352.

[2] Tardieu, *op. cit.*, p. 291.

[3] "Med. Jur.," Am. ed., 1892, p. 428.

A case of suffocation in an infant by retraction of the base of the tongue is recorded. It has been stated that negroes have committed suicide by doubling back the tongue into the throat, or, as it is called, swallowing the tongue.[2] In giving anæsthetics, the subject being supine, and the head and neck somewhat flexed, the tongue, epiglottis, and soft palate may fall backward and suffocation may follow. Howard[3] states that pulling the tongue forward under such circumstances may reopen the pharynx, but will not lift the epiglottis. The thorax should be raised and head and neck extended backward. He believes that in giving anæsthetics the head should be lower than the shoulders. In order to avoid vomiting no food should be taken for some hours before the anæsthetic.

Cases are recorded of artificial teeth having fallen from the mouth into the air-passages during anæsthesia and sleep, and in epileptic and puerperal convulsions. It would appear advisable that these teeth should be worn only while eating (Case 13).

Hemorrhage from the lungs, from rupture of an aneurism or from injury of the mouth or throat, may make its way into the air-passages and cause suffocation. So also the bursting of an abscess of the tonsils or other part near the air-passages (Case 7).

Œdema of the glottis from scalding or other irritation of the fauces or glottis, or from disease of the kidneys; tumors pressing on some portion of the air-passages; rapid, profuse bronchial secretion in infants; acute double pleuritic effusion; cheesy glands ulcerating into trachea; simultaneous œdema of both lungs—all of these may cause suffocation (Cases 18 and 49). [For cases of enlarged thymus gland, see Hofmann, *op. cit.*, pp. 587, 588.]

Paralysis of the muscles of swallowing, from diphtheria or other cause, predisposes to suffocation. Progressive asthenia in which the muscles are exhausted; injury of spinal cord or pneumogastrics; paralysis of muscles of respiration from the use of curare; the spasms of tetanus and strychnia poisoning; the entrance of air into the pleural cavities with collapse of the lungs—all tend to cause mechanical suffocation either by pressure or by paralysis (for deaths in epileptics, see Cases 1, 10, 11, 33, and 40).

---

[1] Trans. Mass. Leg. Soc., 1878, i., pp. 14–24.

[2] See Ogston, p. 550.

[3] Med. Times and Gaz., 1878, i., p. 603.

It is not necessary that the air-passages should be *absolutely* closed to cause suffocation.

The *cause of death* is more likely to be pure asphyxia, because of the absence of the complicating pressure of the hand or ligature on the vessels and nerves of the neck, and of fracture of larynx or vertebræ.

Symptoms.—Foreign bodies[1] entering the trachea naturally fall toward the right bronchial tube instead of the left because of the size and position of the entrance of the right tube. If then but one tube is involved, the signs will usually be on the right side; whereas if the foreign body stop in the larynx or trachea, both sides will be affected. The latter condition is much more dangerous. The symptoms would be resonance over the lung with the respiratory murmur partly or wholly absent; less mobility; puerile breathing on the unaffected side. In either case there may at first be little disturbance, especially if the shape of the foreign body is such as not to greatly interfere with the access of air; otherwise there may be at once, and almost always will be after a time, more or less urgent dyspnœa. Diminution of the necessary oxygen may cause convulsions, apoplexy, and other brain symptoms. Acute emphysema of the portion of lung not obstructed may follow its forcible distention. The local effect of the foreign body is an irritation which causes spasm and cough. It may be carried upward by the expirations and downward again by each inspiration. Inflammation is likely to appear eventually and may involve the lung. If the obstruction is not complete there may follow periods of alternation of good and bad health, ending perhaps in recovery. The foreign body may be expelled after a greater or lesser interval. On the other hand death may result from secondary causes. In the absence of correct history the symptoms may lead to a wrong diagnosis and inappropriate treatment; as where a patient whose symptoms resulted from the presence of a piece of bone in the larynx, was treated for syphilis. A foreign body may be coughed up from the lung into the trachea and fall backward into the opposite lung.

---

[1] Johnson, Lancet, 1878, ii., p. 501.

Partial closure of the larynx, most likely caused by a flat or irregular substance, rather than globular, may cause gradual asphyxia with symptoms of apoplexy, making the diagnosis difficult.

When a foreign body remains a long time in the larynx, spasmodic cough and croupy breathing usually ensue, expectoration tinged with blood, hoarseness, or complete aphonia, pain, dyspnœa, possibly crepitation and dulness over the lungs. The case may end suddenly in death from closure of the glottis, or the foreign body may pass into the trachea and set up a new train of symptoms, or it may be expelled.

The frequency with which foreign bodies in the pharynx or œsophagus obstruct respiration, and the facility with which they may usually be removed, suggest a careful examination. Otherwise the patient may be treated indefinitely for supposed obstruction in the air-passages. Foreign bodies in the œsophagus have perforated into the trachea, and even the lungs, heart, and aorta.

In complete suffocation death will occur in from two to five minutes (see remarks under Strangulation). Death may also occur instantaneously.

The experiments of the Committee on Suspended Animation[1] showed that when the trachea of a dog was exposed, incised, and a tube tied in, the average time covered by the respiratory efforts after stopping up the tube with a cork was four minutes five seconds; the heart-beat stopping at seven minutes eleven seconds on the average. After four minutes ten seconds it seemed to be impossible for the dog, unaided, to recover. Faure[2] made the following experiment upon a large dog: He fixed a cork in the trachea. At first the dog was quiet; it then extended its neck, parted its jaws, and made efforts as if to vomit; then tried to walk, but its gait was uncertain; fell down and rose up. Its eyes became dull, and finally it fell down on its side, and became convulsed; then after several seconds stretched itself out. The thoracic movements were at first tumultuous, then became rapidly feeble; the heart beating very slowly. At the necroscopy the lungs filled the thorax, were full of thick dark blood and emphysematous. The blood was black and fluid in the left ventricle and arteries, and in the right cavities and veins resembled molasses. Liver darkly congested. There was no mucus in the trachea and no ecchymosis in the lungs. He also (p. 306) tried the experiment upon a large dog of fastening boards against its thorax and tightening them by means of cords. For some minutes it was quiet, but suddenly it became much agitated, stood upon its hind legs, threw itself against the wall, rolled on the ground, and uttered frightful cries; finally fell on its side. There was no movement of the thorax, but the muscles of the neck and belly were in full and rapid action, dry and sonorous râles were heard, and a large quantity of mucus appeared at the nose and mouth. The movements grew feebler, the respirations infrequent, and at the end of thirty-four minutes it was dead. The necroscopy showed the blood black and thick; heart relaxed; lungs red, a little emphysematous, containing but little blood, and on their surface were blackish points and small red spots.

---

[1] Med.-chir. Trans., 1862, xlv., p. 449.

[2] Archiv. gén. de Méd., 1856, vii., p. 300.

The death of Desdemona (Shakespeare's "Othello") has been much criticised. The declaration that she was strangled (or suffocated) does not consist with the symptoms described (see *Med. News*, Philadelphia, May 1st, 1886, p. 489).

TREATMENT.

The obvious indication is to search for and remove the obstruction. The means and methods of treatment are fully treated of in surgical works, but may be briefly mentioned here.

Laryngoscopical examination may be necessary. A curved forceps is usually the best instrument for removing the foreign body. A tallow candle may serve to push it into the stomach if there is no bougie at hand. Suction may be used. Sneezing may be brought on by tickling the nostrils; coughing by tickling the glottis; vomiting by irritating the fauces, or by emetic; the body of the subject may be inverted and in this position the fauces may be tickled, or fingers may be passed back into the pharynx. Johnson[1] says that at the moment of inversion the patient should try to take a deep inspiration; this opens the glottis and facilitates the expulsion of the foreign body. The inspiratory current has no appreciable effect in retarding the movement of the foreign body in the direction of gravity.

Noble recommends inversion of the body in new-born infants in which asphyxia may be supposed to be due to anæmia of the brain. Tracheotomy or laryngotomy may be necessary. It may be necessary to administer oxygen. Foreign bodies like beards of grass and fish-heads can be withdrawn only with difficulty because of their sharp projections. Intense suffering and dyspnœa in a robust subject may necessitate venesection. Generally speaking it is better to bring up the foreign body than to push it down into the stomach. Beveridge suggests to blow into the ear, to induce a reflex action and cause expulsion of the foreign body. Cold affusions, artificial respiration, galvanism, frictions of the limbs, artificial heat, stimulants by mouth and rectum, may one or all be needed.

---

[1] *Op. cit.*, p. 539.

Hamilton[1] says that it is useless to expect good results from electricity if five minutes have elapsed since life appeared to be extinct; Althaus,[2] that three hours after death the muscles will cease to respond to faradization; and Richardson,[3] that a low temperature prolongs the sensitiveness of the muscle.

With regard to insufflation, Le Bon[4] objects to it in asphyxia as being hurtful and not useful. Colin[5] tamponed the trachea of a horse; in four minutes fifty seconds it was apparently dead; the tampon was removed and insufflation practised for fifteen to twenty minutes without effect. He claims that artificial respiration is useless after the circulation ceases.

Fell[6] and O'Dwyer[7] recommend forced inspiration. McEwen[8] uses a tracheal tube by the mouth.

Dew[9] offers a new method of artificial respiration in asphyxia of the new-born; Lusk[10] considers the subject of life-saving in still-births; Forest,[11] artificial respiration in the same; Read[12] discusses Schultze's method with approval; Duke[13] plunges the infant into hot water; Richardson[1] recommends artificial circulation by injection of vessels, or electric excitation; Jennings[2] recommends the same; Richardson[3] also considers fully the subject of artificial respiration and electrical excitation; Woillez[4] has described and recommended what he calls a spirophore.

---

[1] "Amer. Pract.," 1872, vi., pp. 193–206.

[2] Brit. Med. Jour., 1879, i., p. 970.

[3] "Nature," 1879, xx., p. 108.

[4] Gaz. hebd. Méd., Paris, 1872, ix., p. 806.

[5] Bull. Acad. Méd., Paris, 1876, v., p. 764.

[6] Jour. Amer. Med. Ass., 1891, xvi., p. 805.

[7] Trans. Amer. Pæd. Soc., 1891, iii., pp. 128–132.

[8] Brit. Med. Jour., 1880, ii., pp. 122–124 and 163–165.

[9] Med. Rec., N. Y., 1893, xliii., p. 289.

[10] Amer. Jour. Med. Sci., 1891, ci., pp. 109–116.

[11] Coll. and Clin. Record, 1892, xiii., pp. 170–172.

[12] Glasgow Med. Jour., 1885, xxiv., pp. 344–354.

[13] Med. Press and Circ., 1889, xlviii., p. 433.

After the removal of a foreign body the irritation remaining may cause a sensation as if the body was still lodged.

Death may occur from hemorrhage after its removal.

POST-MORTEM APPEARANCES.

These are mainly those of asphyxia. There may also be evidences of external violence, homicidal or accidental, as of pressure on the chest. Persistent deformity, flattening of the nose and lips, and excoriation of these parts may result from forcible closure of mouth and nose.

The SKIN AND CONJUNCTIVA usually show patches of lividity and punctiform ecchymoses; especially lividity on the lips and limbs. The face may be pale or violet; it is often placid, especially if the suffocation is accidental. Tardieu[5] admits that infiltration of the conjunctiva and punctiform ecchymoses of the face, neck, and chest may also be found sometimes in women after severe labor, and in epileptics. He records the result of the examination of those who died from suffocation at the Pont de la Concorde, 1866. The face and upper parts of the trunk were generally light red to a deep violet or black color, with punctated blackish ecchymoses on the face, neck, and upper part of chest.

The EYES are usually congested. Mucus and sometimes bloody froth are found about the NOSE and MOUTH. The TONGUE may or may not protrude.

The BLOOD is usually dark and very fluid. Wounds after death may bleed. According to Tardieu[6] fluidity of the blood is most constant in compression of the chest and abdomen, as also its accumulation in the vessels and right side of heart. Its color varies from red to black.

---

[1] Asclepiad, 1885, ii., pp. 171–187.

[2] Lancet, 1885, i., pp. 245–247, 289–292.

[3] Asclepiad, 1890, vii., p. 201.

[4] Bull. Acad. Méd., Paris, 1876, v., pp. 611, 754, 904; and 1881, x., pp. 847–852.

[5] *Op. cit.*, p. 279.

[6] *Op. cit.*, p. 288.

The BRAIN and pia mater are generally congested. This is said to be invariable if the eyes are congested. Mackenzie in thirteen cases found the brain congested in all.

The HEART varies much in appearance and condition. The right side is often full of blood; occasionally empty. Sometimes subpericardial ecchymoses are found, usually along the coronary vessels. The blood in the heart may be partly coagulated if the agony has been prolonged and there has been a partial access of air, which is gradually diminished. Mackenzie[1] found the right cavities full and the left empty in nine out of thirteen cases. Johnson[2] as a result of experiment on animals claims that when access of air is prevented there is a rise in pressure in the arteries, the right side of the heart fills, the pulmonary capillaries become empty, and therefore the left side of the heart becomes empty. As a result of further experiments[3] he verified his former conclusion, and added that in the last stage of asphyxia there is increased pressure on the pulmonary artery and lessened pressure in the systemic vessels. He thinks[4] that when both sides of the heart contain blood, there is paralysis of vaso-motor nerves and the arteries.

The TRACHEA is usually bright red and often contains bloody froth. The LARYNX or trachea as well as PHARYNX or ŒSOPHAGUS may contain a foreign body. If the latter has been removed the resulting irritation may be seen. The LUNGS are sometimes congested, at others normal; color red or pale. Sometimes one lung only is affected. They may be emphysematous. Mackenzie found them congested in all of thirteen cases examined by him. The lungs of young persons may be found comparatively small, almost bloodless, and emphysematous. Tardieu, Albi, and others believed that the *punctiform subpleural ecchymoses* indicated suffocation, and were due to small hemorrhages from engorged vessels which ruptured in the efforts at expiration. These spots are usually round, dark, from the size of a pin-head to a small lentil, and well defined. They are not like the petechiæ in the lungs and heart after purpura, cholera, eruptive fevers, etc., nor like the hemorrhages under the scalp after tedious labor, all of which are variable in size. These punctiform spots are usually seen at the root, base, and lower margin of the lungs. Hofmann states ("Lehrbuch") that they are found in the posterior part of the lungs and in the fissures beween the lobes. They are indisputably frequent after death from suffocation, and if well marked either in adults or infants that have breathed, they indicate suffocation, unless some other cause of death is clear. Simon, Ogston, and Tidy, however, have shown that they are sometimes absent in fatal suffocation, and are sometimes present in the absence of suffocation, as after hanging and drowning; in fœtuses before labor has begun; often in still-births, although some of these are probably due to suffocation from inhaling fluid or from pressure. Also in death from scarlet fever, heart disease, apoplexy, pneumonia, and pulmonary œdema. Grosclaude[1] quotes from Pinard, who declares that these ecchymoses are found in fœtuses which die from arrest of circulation. Grosclaude himself made a large number of experiments on animals by drowning, hanging, and strangling, and fracturing the skull. The ecchymoses were found in nearly all the cases.

---

[1] Indian Med. Gaz., 1890, xxv., p. 257.

[2] Brit. Med. Jour., 1877, i., p. 444.

[3] *Ib.*, 1891, p. 399.

[4] Lancet, 1889, ii., p. 255.

The ecchymoses are partly the result of venous stasis, which overcomes the resistance of some capillaries; and the latter rupture, partly from the aspirating action of the thoracic wall, the lung being unable to fill itself with air, but mainly[2] from vaso-motor contraction and lateral pressure at the maximum of the asphyxia, the time of tetanic expiration. If the asphyxia is interrupted before this stage, the spots do not appear. Similar ecchymoses may be found under the scalp, in the tympanum, retina, nose, epiglottis, larynx, trachea, thymus, pericardium, in the parietal pleura, along the intercostal vessels, rarely the peritoneum, in the stomach, and sometimes the intestines; and in other parts of the body, especially the face, base of neck, and front of chest; in convulsive affections, as eclampsia and epilepsy, and in the convulsions of strychnia and prussic acid poisoning there may be suffusion and congestion of the lungs though not the punctated spots.

Mackenzie, in thirteen cases of suffocation from various causes, failed to find the Tardieu spots either externally or internally. Briand and Chaudé[3] state that they are less constant and characteristic in those who have been buried in pulverulent substances.

---

[1] Paris thesis, 1877, No. 327.

[2] Hofmann, "Lehrbuch," p. 514.

[3] "Méd. Lég.," 1874, p. 406.

Ogston[1] holds that in infants that are smothered the ecchymoses are found in greater number in the thymus gland; while in adults dying from other forms of asphyxia they were found only once in that gland. The spots are found in clusters in infants that are smothered, but only single and scattered in adults who die from drowning, hanging or disease. They were wanting in the lungs of but one infant.

They may be recognized as long as the lung tissue is unchanged. The apoplectic spots in the lungs seen in strangulation are not found in suffocation.

Tardieu[2] from experiments on animals and examination of twenty-three new-born infants who showed traces of violence around the mouth, found the lungs rather pale and anæmic, subpleural ecchymoses well marked. All the deaths were rapid. In cases of compression of chest and abdomen[3] the congestion of the lungs was extensive, and pulmonary apoplexy frequent; more so than in other forms of suffocation. He gave strychnia to animals which died in convulsions, and found very irregular and partial congestions, generally not marked because death was so prompt; blood always fluid; no subpleural ecchymoses.

The LIVER, SPLEEN, and KIDNEYS are generally congested; the kidney more than the other organs named. The spleen is said to be often anæmic. Semen has sometimes been found, unexpelled, in the urethra.

Page[4] experimented on three kittens, suffocating them in cinders. The post-mortem examinations showed the veins engorged, left side of heart empty, right side full of dark, half-clotted blood. Lungs distended, much congested, color violet; many small fluid hemorrhages in substance; no subpleural ecchymoses. Frothy mucus tinged with blood in trachea and bronchi; bronchi congested. Brain and abdominal organs normal.

PROOF OF DEATH BY SUFFOCATION.

It is sometimes difficult in a given case to state WHETHER DEATH IS DUE TO SUFFOCATION. There is no lesion which of itself could be accepted as proof. But a collation of the lesions found taken in connection with the surroundings of the body will in many if not in most cases lead to a definite conclusion.

Infants have been found alive four and five hours after having been buried in the earth.[1] If the pulverulent material has penetrated into the œsophagus and stomach, the burial has occurred during life. Exceptionally when burial has occurred after death and traces of the material are found in the air-passages, they are *not* found in the œsophagus or stomach.

---

[1] *Op. cit.*, p. 554.

[2] *Op. cit.*, p. 275.

[3] *Op. cit.*, p. 288.

[4] *Op. cit.*, p. 23.

The committee on "Suffocation," of the New York Med. Leg. Soc., reported[2] the following group of appearances as evidences of death by suffocation: The general venous character of the blood, the turgidity of the larger veins, the congestion of the parenchymatous organs, especially at the base of the brain, the lungs congested in a variable degree and œdematous, frothy mucus in the bronchi, the right side of the heart always fuller than the left. Fitz[3] holds that suffocation is a condition composed of a group of symptoms and appearances due most probably to accumulation of carbon dioxide in the blood and a deficiency of oxygen. The appearances are: The blood dark and fluid (though in gradual suffocation there may be clots in the right side of the heart), the right side of the heart full, venous congestion of the lungs (not constant), interstitial emphysema of the lungs, and venous congestion of the liver, kidneys, and brain. He prefers the word *engorgement* to congestion in this connection.

Fadeuilhe[4] attributes death from suffocation in close places, as trunks, not only to deficiency of oxygen and increase of carbon dioxide, but to a crowd (*foule*) of toxic compounds, from the skin, lungs, digestive canal, etc.

Tardieu[5] holds that when in infants buried in pulverulent substances we find emphysema of the lungs in high degree, bloody froth in the air-passages, abundant subpleural and subpericardial ecchymoses and the blood fluid, the burial has occurred during life. The same lesions are found in small animals similarly treated.

It must not be forgotten that an intoxicated person or one in an epileptic spasm is practically helpless, and can, therefore, be suffocated, accidentally or otherwise, under circumstances in which one in possession of his senses would be able to escape.

ACCIDENTAL, HOMICIDAL, AND SUICIDAL SUFFOCATION.

Accidental suffocation is frequent, as has already appeared. **Suicidal suffocation** is very rare. **Homicidal suffocation** occurs. Foreign bodies have been forced into the air-passages. Smothering has been done by holding the face in various materials to prevent access of air; by pressure on the chest; by forcible closure of the mouth and nose as in burking; by laying compresses over the face, as in the case of King Benhadad,[1] whom Hazael killed. "And it came to pass on the morrow that he took a thick cloth and dipped it in water, and spread it over his face, so that he died; and Hazael reigned in his stead." Benhadad was already quite ill and not expected to live.

---

[1] Tardieu, *op. cit.*, pp. 296, 298.

[2] Physician, etc., New York, 1880, xiii., p. 181.

[3] Trans. Mass. Med.-Leg. Soc., 1878, i., pp. 14–24.

[4] Lyon thesis, 1896, No. 55 (102 pp.).

[5] *Op. cit.*, p. 291.

Death by suffocation[2] may be considered as presumptive of homicide unless the facts are already referable to accident.

In infants, suffocation is, of course, either accidental or infanticidal; in adults usually accidental. The absence of signs of a struggle in adults suggests accident; unless there is cause of suspicion of previous stupefying with narcotics.

Taylor[3] calls attention to a dangerous practice among some attendants upon infants, of putting into the mouth of the child to quiet it a bag containing sugar; and instances a case in which the child would have died of suffocation but for the fortunate discovery of a part of the bag protruding from the mouth.

In ten years, 3,612 deaths were reported in the city of London, of infants smothered by being overlaid.[4]

Infants may be born into a mass of blood and fæces, from which the unattended mother in her weakness may be unable to remove them.

Page[5] shows by experiment that the inspiratory effort when violently exerted is sufficient to convey small objects into the air-passages. Cinders passed thus into the trachea and œsophagus of kittens and rabbits. Berenguier[6] experimented on new-born pups, placing them in ashes, plaster, and starch. In ashes they lived fifteen hours; these found their way into the middle of the œsophagus, but were stopped at the glottis. Plaster and starch formed a paste with the oral mucus and the movement of the mass was not so great as the ashes. In no case did either of the materials pass beyond the glottis. Tardieu[7] examined three infants which had been buried during life. One was in ashes; the nose was obstructed, mouth full; ashes also in the œsophagus and stomach, but none in larynx or bronchi. The second infant was in manure; a greenish stuff was found in the mouth and stomach. The third in bran (confessed to by the mother); the nose and mouth were full, but there was none in the throat; a few grains in the trachea. Tardieu experimented on rabbits and Guinea pigs by burying them in bran, sand, and gravel, some of them being alive and the others dead. In those buried alive he found the substance filling the mouth and nose to the base of the tongue; in most of the cases the œsophagus and trachea were not penetrated. In the animals first killed and then buried, the substance had not passed into the mouth or nose. In one case only he found ashes in the larynx and trachea of a rabbit which had been buried many hours after death in a box of ashes. Matthyssen[1] held a Guinea pig, head downward, with its nose under mercury; the lungs were full of globules of mercury (which has a specific gravity of 13.5). A dog was plunged head first into liquid plaster-of-Paris; the plaster was found in the bronchial tubes.

---

[1] Second Kings, viii., 15.

[2] Taylor, *op. cit.*, p. 482.

[3] *Op. cit.*, p. 434.

[4] Taylor, "Med. Jur.," Am. ed., 1880, p. 485.

[5] *Op. cit.*, p. 31.

[6] Jour. de Méd. de Toulouse, 1851, iii., p. 237.

[7] *Op. cit.*, p. 295.

ILLUSTRATIVE CASES.

ACCIDENTAL.

1. *Huppert: Vier. ger. Med. und öff. San.*, 1876, *xxiv.*, *pp.* 237–252.—Two cases. A man choked by piece of bread in pharynx. Second, an epileptic, suffocated by *flexion of chin on larynx.* In both cases seminal fluid was found in urethra near meatus, unexpelled; determined by microscope.

2. *Johnson: Lancet*, 1878, *ii.*, *p.* 501.—Boy swallowed penny, became black in face; eyeballs protruded; symptoms soon subsided. Some hours afterward it was found that he could not swallow solids, and liquids only with difficulty and coughing. Throat much irritated; discharge of mucus sometimes tinged with blood, from mouth; moist rattling noise in throat in respiration; frequent cough; could not sleep. Laryngoscope showed penny in upper part of œsophagus, just below laryngeal opening. Removed by long curved forceps.

3. *Ibid.*—Man suddenly fell while at dinner; face blue; breathing stertorous. Died. Piece of tendon found under epiglottis.

4. *Ibid.*—Boy, age 5 years. Button in larynx. Aphonia, dyspnœa, stridulous breathing. Distress gradually subsided. Many years afterward found mucous membrane of larynx thickened; vocal cords red and uneven.

5. *Ibid.*—Man, drunk, swallowed a half-sovereign. Urgent dyspnœa; pain in throat; aphonia; stridulous breathing; dysphagia; cough; copious mucous expectoration. Laryngoscopic examination showed coin in œsophagus. The crico-thyroid membrane was incised and coin pushed upward and ejected.

---

[1] Ann. d'Hyg., 1843, xxx., p. 225.

6. *Med. Times and Gaz.*, 1874, *i.*, *p.* 486.—Man, age 20, had severe dyspnœa. In taking a living fish in his teeth (it was about four inches long and had large dorsal fin), the fish passed into the pharynx and lay doubled up. Impossible to remove it because of spines. Tracheotomy at once. Twenty-four hours afterward the fish had decomposed enough to be partly removed. Patient died of exhaustion.

7. *Littlejohn: Edin. Med. Jour.*, 1875, *xx.*, *p.* 780.—Woman found dead in bed. Suffocated by pus from abscess of tonsil which burst during sleep. Found pus in air-passages down to smallest bronchi; lungs congested; right side of heart distended with dark fluid blood; left side contracted and nearly empty. Blood everywhere fluid. Some lividity of face. The woman had died quietly lying beside her husband, who was not awakened.

8. *Sayre: New York Med. Jour.*, 1874, *xix.*, *p.* 420.—Girl, age 7, swallowed a bead. Had continuous cough; much pain under middle of sternum. The bead moved upward and downward in respiration. Tracheotomy. Four days afterward she coughed the bead out, inspired once, and apparently died. Artificial respiration used; alcohol injected into rectum; galvanization of phrenic nerves. She finally coughed up a piece of thick mucus and recovered.

9. *Duffy: Trans. Med. Soc. No. Car.*, 1874, *p.* 126.—Boy, age 8, swallowed a cow-pea. It lodged in the trachea. Some months afterward, laryngotomy performed. The boy seemed to die at once. Artificial respiration used. After a while he expelled first some mucus, then the pea. Recovered.

10. *Tardieu: Op. cit.*, *p.* 290.—Man, age 50, found dead on the floor. At base of neck and front of chest were many punctated ecchymoses. Brain and lungs much congested; the latter showed subpleural spots. Tongue and lips bitten. Death was due to cerebral and pulmonary congestion from an epileptic seizure.

11. *Oesterlen: Vier. f. ger. Med. und öff. San.*, 1876, *xxiv.*, *p.* 10.—Woman, age 30, epileptic. Found dead. Examination showed signs of asphyxia; blood-vessels engorged, marked œdema of lungs, etc. Opinion given that she died in epileptic paroxysm, and certain injuries observed were caused by a fall.

12. *Tardieu: Op. cit.*, *p.* 322.—Two children, one 2 months old, the other 18 months old; in bed together. The older overlay the younger, which died. Necroscopy: lungs voluminous, in places congested, in others pale; abundant subpleural ecchymoses; quite emphysematous. Fluid blood in heart.

13. *Blum: New York Med. Jour.*, 1885, *xlii.*, *p.* 207.—Woman, found dead. Vulcanite plate of usual size, with four teeth attached, found wedged in trachea about two inches below larynx.

14. *Wyeth: Same journal*, 1884, *xl.*, *p.* 487.—Boy, age 12, inspired a pin-dart in trying to blow it through a blowgun. Violent cough,

gasping for breath, lividity of face for a few minutes; symptoms subsided leaving slight cough. The dart had lodged in right bronchus beyond first bifurcation, as shown by hissing, fluttering sound in both inspiration and expiration. Tracheotomy. The dart could not be reached. At a later date the dart was brought up into the mouth by a strong expiration.

15. *Partridge: Same journal*, 1890, *li.*, *p.* 303.—Child, 4 months old, found dead; fluid, partly digested milk in air-passages.

16–41. *Biggs and Jenkins: Same journal*, 1890, *lii.*, *p.* 30.—Report of many cases of fatal suffocation from foreign bodies, etc. Boy, age 15—collar-button in larynx .Boy, age 10—mass of butter in larynx. Boy, age 5—bronchial gland discharged into trachea at bifurcation. Boy, age 3—screw in larynx. Boy, age 5—rubber balloon with whistle attached; it was partly inflated with each expiration. Girl, age 10—a "jack" in larynx. Man, age 45—had been drinking freely; piece of meat in larynx. Man, age 40—piece of meat in larynx and pharynx. Man, age 40—ditto. Insane patient—piece of meat in trachea. Man—piece of meat in larynx. Man, age 40—crackers and cheese in larynx. Child—rubber nipple in larynx. During administration of ether, patient vomited; vomitus entered larynx. Two children in bed asleep; one, 3 years old, overlay the face of the younger, age 5 months. Woman, age 25, epileptic—fell on a child and smothered it. Two children found dead, covered with bedclothing. Man, age 21, epileptic—found lying on his face in bed. Girl, age 12, epileptic—ditto. Woman, age 21—ditto. Girl, age 18—ditto. Woman, age 35, epileptic—fell on the floor. Woman, age 28—ditto. Man, age 35, epileptic; vomited while in spasm; vomitus entered larynx. *From Dr Janeway:* Man, epileptic, fell on his face in pile of manure, which entered larynx. Man, drunk, lying on his face.

42. *Roy. Indian Med. Gaz.*, 1880, *xv.*, *p.* 71.—Man, believed to be drunk, had vomited in bed; vomitus entered trachea and bronchi.

43–47. *Mackenzie: Same journal*, 1890, *xxv.*, *p.* 257.—Reports fatal cases: Boy—bone button in larynx. Sailor—meat in larynx. Boy—vomited matter in larynx. Infant—while taking the breast, a rush of milk suddenly filled the air-passages. Also three cases of crushing under walls; two buried in loose earth; two crushed in a crowd; one by bags of grain.

48. *Feulard: Bull. Soc. Anat.*, 1883, *viii.*, *pp.* 384–386.—Woman, age 79. Piece of beef in larynx. Necroscopy showed hematoma in dura mater.

49. *Poupon: Bull. Soc. Clin., Paris* (1882), 1883, *vi.*, *pp.* 236–238.—Boy, age 5½ years. Death from cheesy gland in trachea.

50. *Pons: Jour. Méd., Bordeaux*, 1889–1890, *xix.*, *pp.* 57–61.—Woman, age 24. Death from œdema of larynx from presence of particles of food.

51. *Kemény: Wien. med. Blat.*, 1890, *xiii.*, *p.* 37.—Man, age 45. Suffocated by curdled milk in air-passages.

52. *Maschka: Vier. ger. Med.*, 1885, *xliii.*, *pp.* 11–14.—Man, age 65. Accidental compression of chest.

53. *Heidenhain: Same journal*, 1886, *xliv.*, *pp.* 96–101.—Vomited matter passed into air-passages while subject was drunk.

54. *Langstein: Wien. med. Woch.*, 1880, *xxx.*, *pp.* 624–626.—Child found dead in bed; had vomited food while asleep and breathed it into air-passages.

55. *Ward: Catalog. Army Med. Mus.*, *Med. Sec.*, *p.* 33.—Soldier, age 17; choked to death by lumbricoid worm passing from pharynx into right bronchus. Specimen 7,737.

See also *Beebe*, *Jour. Amer. Med. Ass.*, 1898, *xxx.*, *p.* 227.—Tobacco quid impacted in pharynx; removal and recovery.

SUICIDE.

56. *Sankey: Brit. Med. Jour.*, 1883, *i.*, *p.* 88.—Epileptic; found dead in bed, lying on his back. A round pebble in each nostril; strip of flannel rolled up and stuffed in throat.

57. *Macleod: Ibid.*, 1882, *ii.*, *p.* 1246.—Suicidal maniac. Had to be fed because he refused food. Was seen to be blue in the face and breathing hard. His mouth was forced open; roll of flannel found in throat. Macleod refers to another case, a woman in dissecting-room, with similar roll of flannel in throat.

See Tidy, "Med. Jur.," Cases 15 to 17.

HOMICIDE.

58. *Christison: Edin. Med. Jour.*, 1829, *xxxi.*, *pp.* 236–250.—The famous Burking case. A woman was struck down to a sitting posture. Burke then threw himself on her, kept her down by the weight of his body, covered her mouth and nose with one hand and placed his other hand under the chin for ten to fifteen minutes, till she died. Necroscopy showed a severing of the posterior ligamentous connections of the third and fourth cervical vertebræ, with blood in spinal canal but not under the dura mater; cord not injured. Christison made experiments to ascertain if the injury to spine had been made during life.

59. *Hackel: Dorpat Diss.*, 1891, *p.* 35.—Case of choking with pressure on breast and belly. Woman found lying on floor, with many injuries.

60. *Tardieu: Op. cit.*, *p.* 315.—New-born infant; found buried in earth. Mother stated that the child had not breathed. Putrefaction had begun. There was a brownish tint of skin of upper front part of neck below jaw; drops of sanious fluid flowing from nose; umbili-

cal cord had not been tied; subcutaneous hemorrhage in right temporal region; brown bruised surface and contused wounds of pharynx, where particles like ashes and vomited matter were found. Lungs filled the pleural cavities, were rose-colored and showed abundant punctated subpleural ecchymoses; bloody, frothy mucus in trachea and bronchi; some serum in pericardium; respiration had been complete. Opinion given, that the infant had been suffocated by obstruction of pharynx, probably by fingers.

61. *Tardieu: Op. cit., p.* 323.—New-born infant found under a cask, partly eaten by a dog. The head showed transverse flattening and subcutaneous hemorrhage. Lungs voluminous, rosy; abundant subpleural ecchymoses; hemorrhage in left lung. Heart filled with fluid blood. Coagulated blood in abdomen. Opinion given, suffocation by pressure on head, chest, and abdomen. The mother confessed that she had placed the child under the cask.

62. *Ibid., p.* 325.—New-born infant found buried in the earth; gravel and earth in pharynx and œsophagus down nearly to stomach, and in trachea and right bronchus. Lungs congested, crepitant. Opinion given, that the child had been buried while living.

63. *Ibid., p.* 326.—New-born infant found in ashes; nose and lips obstructed, mouth filled; ashes in œsophagus and stomach; none in larynx or trachea. Lungs distended with air, emphysematous; subpleural ecchymoses; fluid blood in heart.

64. *Ibid., p.* 327.—New-born infant, buried in bran; nose and mouth filled; some in trachea; none in œsophagus or stomach. Lungs distended with air, emphysematous; subpleural ecchymoses; heart empty.

65. *Devergie and Raynaud: Ann. d'Hyg.*, 1852, *xlviii., pp.* 187–206.—Man found dead on a pile of grain; mouth, nose, and eyes contained some of the grain; some also in stomach, larynx, trachea, and bronchi. Some marks of injury on face and other parts of body. Internal signs of asphyxia. Opinion given, that the case was homicide. The defence offered was that the man had fallen into the grain.

66. *Rauscher: Friedreich's Blat.*, 1886, *xxxvii., pp.* 324–330.—Woman, age 71, suffocated by a cloth over nose and mouth.

See Tidy, "Med. Jur.," Cases 1 to 11; also Fadeuilhe, *Lyon thesis*, 1896, *No.* 55, *p.* 68 *et seq.*

DEATH FROM SUBMERSION

IN ITS

MEDICO-LEGAL RELATIONS.

BY

IRVING C. ROSSE, A.M., M.D., F.R.G.S. (Eng.).

DEATH BY SUBMERSION OR DROWNING.

GENERAL CONSIDERATIONS.

THE frequence and importance of drowning having arrested attention from the days of Noah's Ark and those of Hippocrates down to the present time, it is quite possible to array in chronological order the fictitious, transitory, and positive periods that mark the sequence of ideas touching the subject.

Mooted questions relative to drowning have been debated since the fourteenth century; and modern statistics show the great development of this class of emergency, than which none is of more startling character. In France between four and five thousand cases of this kind of accident are officially recognized each year, which is about one-third of all the accidental deaths, and the number appears to increase yearly. Nearly the same figures apply to the inland waters of England and Wales, not including the coast. The Board of Trade Return shows that out of 86,695 seamen who died in English ships abroad, 53,673 were drowned, and a late report of the Fisherman's Federation places the number drowned in the inland waters and upon the immediate coasts of the United Kingdom and its adjacent islands as 6,268 annually. The many hundreds drowned in the late *Victoria* disaster and in the great storm that swept the British Isles are matters of current knowledge. In our own country accounts of drowning are of daily occurrence, and help to the drowning forms the greater part of the work done by that noble governmental branch, the Life Saving Service. Not only does the sea claim its numerous victims, but the great floods and cyclones have destroyed thousands, while on the lakes and rivers drowning accidents are lamentably frequent. If the statistics of such accidents were as available as those of the late war, for instance, the exhibit would doubtless be surprising. Where the aggregation of killed in action is shown to be 67,058, there were drowned 106 officers and 4,838 men.

The small regular army lost 5 officers and 89 men from this cause; the negro troops, 6 officers and 289 men; and the volunteers furnished a large contingent, the State of Ohio alone having lost 14 officers and 770 men from drowning.[1]

Aside from the point of view of public hygiene and that of pathology, further evidence is not wanting to show the medico-legal value of the phenomena of drowning, and the frequency and importance of the judicial questions that may arise in this class of accidents.

DEFINITION AND PHENOMENA OF DROWNING.

Late studies as to the cause and mechanism of *asphyxia by submersion* or drowning warrant our speaking of submersion as immersion complete enough to menace or to extinguish life.

When an animated body or a part only of the body is immersed a sufficient time in water or any liquid medium whatever in such a way as to exclude fresh air from the respiratory orifices, suffocation follows, and death by submersion or drowning takes place.

The phenomena occurring in such instances are mostly those common to imperfect aeration or non-aeration of the blood, and for this reason the majority of medical writers describe asphyxia or apnœa, that is, death beginning at the lungs, as the determining cause of death by drowning. It must not be thought that asphyxia is always the mode of death in those submerged, although it is commonly present in a certain number of cases. Other causes may often modify the circumstances of the death or directly produce it, as congestion of the brain and syncope, or the cause of death may be a mixed one. Occasionally one reads accounts of persons resuscitated from drowning who, on recovering from the primary effects of the asphyxia, die suddenly without apparent cause after a lapse of a few minutes or several days. Such cases are explained as the secondary results of the arrested interstitial nutrition that took place during the period while breathing was temporarily arrested. Another secondary cause is physical injury to the lungs from water penetration, which may result in a fatal pneumonia. A case related in England is that of a drowning boy who, on being resuscitated after submersion in contaminated water, suddenly died of cholera.

---

[1] See writer's "Bathing and Boating Accidents," Jour. American Medical Association, April 19th, 1890.

MODE OF DEATH IN DROWNING.

Since various lesions may be found, accordingly as the death from drowning has taken place from one or more of the foregoing modes, it is necessary to have a clear notion of asphyxia and to study in detail the mechanism of arrest of the thoracic movements and of the hindrance to hæmatosis.

Broadly speaking, there will be asphyxia when any obstacle hinders air from entering the pulmonary vesicles, or when the fluid that penetrates them is of any other nature than the medium in which the animal is destined to live. Consequently the name asphyxia is applied generically to all accidental conditions in which life is threatened by any intervention whatever of the respiration. (See MECHANICAL SUFFOCATION, Vol. II., p. 223 *et seq.*)

Submersion in any liquid medium causes asphyxia. This condition may be caused on being surrounded by a medium devoid of oxygen and improper to support sufficient hæmatosis, as hydrogen, nitrogen, and the protoxide of nitrogen, gases not toxic properly speaking, but considered irrespirable. Diminished respiration from deficiency of oxygen is the true cause of asphyxia. No animal can maintain the respiratory process in an atmosphere devoid of oxygen or in one that does not contain at least ten per cent of this gas, and such quadrupeds as whales, hippopotami, and seals or the pygopodous birds would drown in the same manner as a dog if kept submerged long enough. The suppression of the gaseous exchange by submersion is also fatal to such aquatic insects as hydrophiles, dytiscidæ, and the like, which drown in the same manner as the hymenoptera, coleoptera, diptera, or other terrestrial insects. Ants drown in less than a minute when the body is wet, and the disappearance of apparent vitality is accompanied by convulsive movements indicating functional trouble of the nervous apparatus. Sir John Lubbock found that after eight hours of immersion they could be restored to life, and several ants after two days and five days were restored to momentary life with feeble motions, followed by death in two hours. Even a terrestrial plant when submerged drowns like a terrestrial animal, the mechanism of asphyxia by submersion being the same in plants and aerian animals, and due to closure of the principal way of gaseous exchange.

Notwithstanding the interruption of the gaseous exchange necessary to support life, there is long persistence of vitality after submersion of some creatures in which an intra-molecular respiration or gaseous dialysis with aerated water takes place, as in ants who have not been wetted before submersion.

The resistance of new-born animals to this mode of asphyxiation is especially noted in the greater time required to drown a pup than an adult dog. One minute and a half usually suffices to drown a dog, while a new-born pup often requires as much as fifty minutes. This great difference is owing to the less active change of tissue and the smaller consumption of oxygen in the young animal. The more active the vital combustion and the greater the demand upon the general store of oxygen in the blood, the quicker the young animal perishes when the respiration is obstructed.

It is observed in a general way that all kinds of death caused by the privation of respirable air have between themselves the greatest resemblance. Whatever be the obstacle that intercepts the connection of the lungs with the atmosphere, the apparent differences are only secondary and the essential symptoms are identical, because all act in suppressing the functions of the blood and hæmatosis. In fact, the phenomena of asphyxia are constant and related to disturbances in the respiration, innervation, and circulation, which vary according as the asphyxia is the result of submersion or of the absence of oxygen in the surrounding medium, according as asphyxia is immediate or slow. The fatal result of asphyxia is owing to the introductory arrest of the pulmonary circulation, the capillaries of the lungs being incapable of conveying venous blood. The stagnation of the blood in the lungs is followed by paresis of the respiratory centre and stoppage of the heart.

STAGES AND SYMPTOMS OF DEATH BY DROWNING.

The authorities are that an individual who dies asphyxiated by submersion passes through three stages. At first he experiences a violent shock, followed by an inspiration of surprise, which results from the contact of water with the lungs causing a reflex cough. Then for some seconds there is a voluntary suspension of respiration, giving rise to other forcible involuntary expirations. In this dyspnœic second period the face and brain become congested, owing to slowing of the encephalic circulation. Loss of consciousness soon follows, when the drowning person enters the third stage, which is that of asphyxia. In this period the individual gasps deeply, the pupils are dilated, the sphincters paralyzed, and the limbs are agitated by clonic convulsions. This is followed by complete insensibility and speedy death.

When a fatal termination in drowning results from that form of neuro-paralysis known as *syncope*, in which death begins at the heart, we infer from experiments that the sudden loss of consciousness arises from the violent impressions that the sensitive nerves convey to the bulb. Such a result is more likely to occur in persons with weak heart and languid circulation, who are more susceptible to fright and shock or to the sudden collapse from intense cold. It is also shown that stammerers, who have a defective innervation of the phrenic and of the pneumogastric, succumb more rapidly than others.

The importance of syncope as a cause of death in drowning is much restricted when we consider the fact that the circulation is the last of the functions extinguished in an animal that for purposes of experiment has been subjected to submersion. This has been shown in a sensuous way by experiment, aided by the resources of the graphic method, which registers the respiratory modifications as shown by the pneumograph and also the condition of the femoral artery in connection with a kymographion. The heart continues to beat as much as three minutes after the animal has succumbed, and recent autopsy gives almost constant proof of asphyxia. In fact, it is held that syncope takes but small part in this form of death, the general agreement of opinion being that nothing short of a syncope that would be fatal either in or out of the liquid medium can account for the entire absence of some of the signs of death from asphyxia.

Among the symptoms often present in drowning persons, many relate to nervous phenomena and the mental state, which may vary with individual presence of mind and moral force. Persons who have escaped this kind of death have observed auditory and visual hallucinations, as flashes of light, the ringing of distant bells, and the like. Just before the outset of the asphyxiation a rather curious functioning of the brain known as hypermnesia[1] takes place, in which the revivescence of ideas, of objects, or of facts relates to anterior impressions long past that seem to have been forgotten. According to the narratives of many drowning persons who have escaped the last consequences of asphyxia, this condition was attended by general exaltation of the memory of such a nature that their whole previous conscious existence seemed, in an incredibly short period and with great clearness and precision, to pass before them in panoramic review. In Admiral Beaufort's letter to Dr. Wollaston, the memory impressions are said to have occurred in retrograde succession. A medical man resuscitated from drowning reports that just before losing consciousness this particular cerebral activity, in his case, took on a most realizing sense of the situation and of the consequences to his family. This cerebral superexcitement is not, however, a constant thing, nor do all subjects experience the ineffable agony of drowning. Persons have been taken from the water apparently dead who, on regaining consciousness, declared that they experienced neither oppression nor suffering and had no recollection of what had passed. A very intelligent woman of my acquaintance, having such an experience a few years since at Newport, quotes herself as and really believes that she is an instance of a person once dead and afterward restored to life.

This peculiar vividness of mind has been observed in other kinds of death than drowning, notably in chronic insanity. A priest with extended experience at the Government Hospital for the Insane tells me that he has often noticed the *vaticinatio morientium* in the form of so-called lucid interval of the insane when called on to administer the last rites of the Church. The condition is explainable from the stoppage of the pulmonary artery and the stimulus caused by circulation of non-oxygenated blood in the brain.

The condition known as asynesia, or amnesia, sometimes follows the return to consciousness in persons asphyxiated and apparently dead from drowning. Dr. F. A. Burrell reports the case of a boy of eighteen, submerged for six minutes and resuscitated after four and three-quarter hours, in whom the memory of everything that had occurred from half an hour previous to the accident up to return of consciousness had been entirely obliterated. When last heard from the lapse of memory still remained.[1]

---

[1] See writer's article, "Memory, Diseases of," in "Reference Handbook of the Medical Sciences." First Edition.

The statement that death from submersion results from true asphyxia or from asphyxia in a more or less modified form rests on the authority of a large number of facts. Indeed, recent investigators make the proportion so much greater than formerly as to warrant the statement that asphyxia is the generic cause of death by drowning. Dr. S. Coull Mackenzie[2] reports 305 cases of drowning, in which 297, or 93.37 per cent, died from asphyxiation; 1, or .32 per cent, from syncope; 1, or .32 per cent, from apoplexy and asphyxia; and in 6, or 1.96 per cent, the mode of death could not be determined because of advanced putrefaction.

As the post-mortem signs of drowning are known to vary according to a number of circumstances, it is difficult to deal with the subject unless certain fundamental points be kept in mind. These relate more particularly to the external signs and to the different lesions that follow the mode of death, although they are not constant. Surgeon-Major E. G. Russell[3] illustrates how widely the post-mortem appearances may vary in cases of drowning, even when the outward circumstances of the period of death are identical and the bodies have been subjected to precisely similar conditions as regards duration of immersion, subsequent exposure to air, and times of necropsy. He relates that five persons were drowned while proceeding to a ship in the Hooghley River. Three died the same death; and at the same time the bodies were recovered together after the same period of immersion, and were examined together; thus from beginning to end they had been under exactly similar conditions, yet there were very marked differences in the state of preservation of the bodies and in the post-mortem appearances. After five hours' exposure in air at 88° F., one body, in which the tissues were extremely fatty, showed beginning decomposition; in the other two there were no signs. Decomposition in the scalp, face, and neck indicative of drowning had begun under water, although in ordinary cases it first invades the abdomen, genitals, breasts, etc. Rigor mortis present in one case was absent in the other. The penis was semi-erect in one case, flaccid in the other, retracted and shrunken in the third. Emission of semen and expulsion of fæces were also noted. Tongue not swollen or protruded in any case, and *cutis anserina* absent in all three, which may have been owing to the high temperature. Water was inspired into the lungs in two cases. The larynx, trachea, and bronchi had regular congestion and scarlet ecchymoses in one case characteristic of asphyxia, and there was muddy water in the stomach.

---

[1] Medical Record, August 22d, 1891.

[2] "Medico-Legal Experience in Calcutta," Edinburgh, 1891.

[3] Indian Medical Gazette, December, 1888.

The first question likely to arise when a drowned body has been found is the one of identity. All the circumstances in which the body was observed before its removal to the place where it lies for examination should therefore be minutely detailed, and all lethal injuries and the like should be noted with care, since the smallest accessories often lead to identification. The locality in which a drowned body is found may be a fact of considerable importance that may help to complete the chain of evidence in which the matter of crime or of accident turns upon the question of identity. It must be remembered that bodies often drift many miles away from the spot where the drowning occurred, owing to tides or currents. Such a circumstance I noted a few years ago at Brownsville, Texas, where it was a common sight to see bloated cadavers going down the Rio Grande. Time and putrefactive changes are also elements that enter into the matter of recognizing the drowned cadaver. To resolve this question with desirable precision, the reader is referred to more detailed instruction in the chapter on Identity.

TREATMENT OF THE APPARENTLY DROWNED.

Help to the drowned does not properly come within the province of judiciary medicine, being rather a humane question that belongs to public hygiene. Systematic writers, however, treat the subject at considerable length, and the statistics of institutions for helping the drowned give such marvellous results that it would manifestly not be out of place to cite briefly some of the means employed for restoring life to persons taken from the water asphyxiated and apparently dead.

The prime object in resuscitating the drowned is the introduction of air into the pulmonary vesicles, which is best accomplished by artificial respiration, and the employment of such means as excite the nervous system with a view to reanimate sensibility and develop the reflex movements that contribute to the re-establishment of the respiratory function.

The exigencies of drowning also call for special means to restore the animal heat and the circulation, as well as the precaution of removing mucus and fluids from the obstructed air-passages.

As the knowledge of securing patency of the air-passages by artificial respiration is generally diffused among medical students and is taught in some schools, it would be superfluous to repeat in detail the procedures of Hall, Sylvester, and others.

Laborde's method of resuscitating those apparently dead has lately gained some notoriety. It consists in stimulating the respiratory reflex by regular rhythmical traction of the tongue, which should be vigorously pulled forward fifteen or eighteen times a minute, to correspond in frequency to the normal respiration.

Another method, alleged to have marvellous effects over the respiration, is that of anal dilatation. Its advocates claim that irritation of the anus is a much more effective measure in resuscitating the drowning or narcotized.[1]

Respiration may be further promoted by alternate dashes of hot and cold water on the face and chest, by smelling-salts, tickling the throat and nares with a feather, and by electrization of the diaphragm and inspiratory muscles. Protracted galvanism may, however, prove dangerous.

When signs of life appear, a warm tonic stimulating drink should be given. A hypodermic injection of caffeine is also recommended.

Whatever means are employed should be used on the spot in the open air and without a moment's delay.

Restorative efforts may be kept up for two or three hours, although in the majority of cases life is extinct in the human subject after two minutes' submersion or even less, and the chance of restoration after five minutes' complete submersion is doubtful. To be sure, trained tank performers remain under water longer than two minutes, and exceptional instances occur of recovery after twenty minutes' submersion in individuals in a state of syncope or with catalepsy.

---

[1] Jour. of Orificial Surgery, April 1st, 1893, p. 709.

CADAVERIC SIGNS IN CASES OF DROWNING.

The signs alleged to be common to death by drowning and characteristic of it are difficult to deal with, for the reason that there are no sure signs of drowning and the lesions furnished by necropsy are of feeble importance. There is consequently a divergence of opinion on this subject.

External Signs.

Among the external diagnostic signs consistent with the supposition of death by drowning, the presence of froth at the mouth and nostrils is of first importance. Cadaveric rigidity, pallor, goose-skin, rosy or violet discolorations on various parts of the body, retraction of the penis and scrotum, fish-like expression of the eye, peculiar position of the tongue, maceration of the palmar and plantar epidermis, and convulsive contraction of the limbs, particularly of the hands, which may be clinched after the manner that marks death by asphyxia, are all signs which when united form strong presumption in favor of submersion.

These typical and classic signs may, however, be varied by many circumstances. Hence the dissidence of authors. Dr. F. W. Draper states that after inspecting 149 drowned bodies, he has never observed that important sign of death, the presence of substances grasped in the hands.[1] Sand or mud in the hollow of the nails and excoriations of the fingers are also regarded as probable, not certain, signs, since each of these might have occurred either before or after death. The peculiar clinched condition of the hand is not pathognomonic, though strongly suggestive of drowning, as it may appear in asphyxiation from other causes. I have lately noticed this among the external appearances of the bodies taken from the Pompeiian excavations. The further index of drowning known as washerwoman's or cholera hand, with non-adherent tendency of the epidermis, is an effect that may be produced upon the living after a prolonged bath, notably in the aged and habitually unclean. Nor is the position of the tongue a special and distinctive characteristic of drowning. I observed its presence in some of the victims of mechanical suffocation in the Ford's Theatre disaster in Washington.

---

[1] Trans. of the Massachusetts Medico-Legal Society, vol. i., No. 8, 1885.

The shrunken state of the genital organs is apparently of little positive value as a thanatological sign, since the negative and opposite state of erection has been often observed, and Dr. Ogston states that he met semi-erection in twenty-two cases.

The value of "goose-flesh" as a link in the chain of evidence is also weakened when we consider that it frequently occurs after other violent modes of death. Anserine skin is often met with during life, and cases of drowning are recorded where this appearance has been absent.

The aspect of the face and the general position of a drowned cadaver may likewise vary according to the mode of death. Immobility of the body in the attitude of agony, the horrible grimaces of asphyxia, the pale, calm features of syncope, and putrefactive changes are further circumstances of medico-legal detail that may complicate the problem and render an autopsy necessary in order to invalidate or confirm the uncertain conclusions furnished by the external signs.

Internal Lesions.

Autopsies on the drowned are remarkable owing to their negative signs. But as an extension of diagnostic means, the autopsy may show the vertical (though not invariable) position of the epiglottis; the presence of water and foreign matter in the bronchi; swelling and emphysema of the lungs; hydræmic engorgement of the liver; fulness of the right heart and emptiness of the left; fluidity of the blood; water in the stomach and middle ear; and a characteristic frothy mucus or lather more or less bloody, which most observers and writers consider the only constant post-mortem appearance of drowning.

Examination of the respiratory apparatus is of extreme importance in a question of this kind, for it is contended that the presence of foreign bodies is a proof of submersion.[1]

This opinion is in part erroneous, since it has been observed that when a body is submerged after death water will penetrate the larynx, trachea, and remote bronchi, as well as the stomach and middle ear. Moreover, Dr. Ogston states that in 48.7 per cent of cases of drowning no water was found in the lungs.

The emphysematous condition of the lungs, which are said to force their way out of the chest on removing the sternum, is difficult to distinguish from the result of putrefaction. Dr. Gilberti shows that in the drowned the lungs disintegrate rapidly, while the heart, in which putrefaction begins chronologically, is relatively in a good state of preservation.[2]

Since many cases have been observed in which both sides of the heart may be partly filled or both be empty and flaccid, or the left side distended more than the right, we are obliged to regard the exceptions concerning this post-mortem sign of drowning as coextensive with the rule.

Excessive fluidity of the blood depends upon the rapidity with which the drowning took place. Slight hydræmia occurs in rapid submersion, but when the drowning has taken place slowly a large amount of water passes into the blood. In certain poisonings by opium this fluidity also exists; but it is claimed that analysis and the spectroscope may clear up the diagnosis.

Hydræmic engorgement of the liver is regarded as a characteristic fact by Lacassagne, who claims to be able to diagnosticate drowning from a single examination of this organ.[3]

It is now generally admitted that the presence in the stomach of a certain quantity of liquid in which the body was found immersed may be considered as a sign almost certain of asphyxia by submersion.

Dr. Fagerlund concludes from his experiments that liquids do not penetrate after death either the stomach or anus unless strong pressure be made. But when asphyxia occurs in water the liquid is found in the stomach and the intestines, where it is helped on by peristaltic movements. The pylorus is an obstacle to the passage of this water, the movement of which is easier when the stomach is empty and the submersion prolonged.[1]

---

[1] Lesser, Dr. Adolph: "Ueber die wichtigsten Sectionsbefunde bei dem Tode durch Ertrinken in dünnflüssigen Medien," Berlin, 1884.

[2] Gilberti, Dr. A.: "I Segni dell' Annegamento nel Cadavere in Putrefazione," 1889.

[3] Barlerin, Paul, le Dr.: "Etude Médico-légale sur la Submersion," Tarare, 1891.

The quantity and quality of the water may constitute important evidence; but to be of full value the water or other fluid found in the stomach ought to be the same as that in which the immersion has taken place.

The liquid, which may have been taken just before drowning, should not be noticed unless it exceeds half a pint; but anything peculiar in the fluids, either of the lungs or stomach, should be subjected to microscopic or other examination.

Presence of water in the middle ear is regarded as a thanatological sign of great value. Dr. Bourgier claims as the result of his examination that 23 cases out of 27 had water in the middle ear. Several German observers pretend to have found amniotic liquid in cases of fœtal asphyxia. The fluid may be aspired by a small pipette.

Many of the foregoing signs and lesions disappear or undergo variable alterations after sojourn in water, putrefaction, etc. They may, as they have done in the past, give rise to many controversies, so that presumptions only can be established. Hence the necessity for careful and detailed necropsy in such cases, with a view not only to minimize conjecture and uncertainty, but to prevent opposing counsel from entering the plea of negligence and incompleteness.

WAS THE DROWNING ACCIDENTAL, SUICIDAL, OR CRIMINAL?

Assuming the probabilities to be in favor of death by submersion, the question next turns upon the character of the event.

In the absence of lesions it is almost impossible to say whether the individual fell in, jumped in, or was pushed in the submerging fluid. The person's antecedents should be inquired into—whether subject to epilepsy, vertigo, intemperance, or mental aberration. Alcoholism is an important factor in accidental drowning, and a person intoxicated may be drowned in very shallow water. A few years ago a young man over six feet tall, while bathing in a tributary of the Potomac River, near Washington, was drowned in only three feet of water. On considering all these circumstances, it may not be possible, even after careful inspection of the body and minute exploration of all the organs, to declare the drowning the consequence of an accident. The existence of traces of violence or of injury which may have occasioned death or disability, of such a nature as to render the person unable to defend himself, would seem to merit particular attention. But their presence leads to further consideration—were the marks of injury caused by the water itself, by some object in the water, or were they self-inflicted? Dislocations, fractures, and other injuries have been caused by jumping or falling into the water from a great height. I know an instance of a professional who, on jumping from a height of ninety feet, split his upper lip on striking the water with his mouth open. The autopsy in the case of Odlum, the Brooklyn Bridge jumper, is said to have shown rupture of the liver. On the other hand, many persons jump from great heights into water with perfect impunity. For many weeks at the London Aquarium a performer has nightly jumped into a tank from an elevation of 127 feet, and several persons have successfully jumped from bridges much higher.

---

[1] Fagerlund, L. W.: "Ueber das Eindringen von Ertränkungsflüssigkeit in die Gedärme," Vierteljahrschrift für gerichtl. Med. und öff. Sanitätswesen," Berlin, 1890.

Objects in the water that may account for cadaveric lesions are numerous. I have known a soldier, a good swimmer, to break his neck on diving from a river bank.[1] Other traumatic lesions may occur in a rapid current, from the breaking up of ice, from the screw or paddle-wheel of a passing steamer, or from aquatic animals.

A matter much discussed in connection with this subject—that of shark-bites—may enter into the question of survivorship where it is alleged that several persons during shipwreck or other disasters at sea have been devoured by sharks. Though an occasional accident, such bites are more a figment of the mind than a reality, as the concurrent testimony of disinterested observers will show. After years of investigation among nautical people and much experience as a swimmer in widely different parts of the world, I have no personal knowledge of such injuries, and have met but two persons that had any actual personal knowledge of shark-bites.

---

[1] Circular No. 3, War Department, Surgeon-General's Office, Washington, 1871, pp. 129–131.

Documentary evidence as to shark-bites is also very scanty. During the last fifty years soldiers by the tens of thousands have swum at Fort Monroe, Virginia, yet there is no record of one having been bitten by a shark; nor have I been able to ascertain that any accident of the kind has occurred at Malta or at Gibraltar. There does not appear to be a record of any one ever having been bitten off the British Isles. I have been unable to ascertain that a single bite of the kind is reported among the medical records of our War or Navy Department or those of the Marine Hospital. In the West Indies but few facts are reported indicating danger from sharks, and these are not well authenticated. The same may be said as to newspaper accounts, which deserve about as much credence as the reports concerning sea-serpents. A few years ago a public journal gave an account of a boy who was bitten while swimming near New York and afterward died in a hospital.

But medical literature has a few reports of shark-bites. After ten years' diligent search I have found seven references, the earliest in the *London Medical Gazette*, 1823, and the latest in the *London Lancet*, 1886. The bites occurred in Australia, South Africa, and India. The Hooghley and Ganges Rivers are the worst place in the world for sharks and alligators. A particular kind of shark, the *Carcharras Gangeticus*, which is very fierce and bold, sometimes dashes among the crowds at the bathing ghâts, and has been known to bite a boy in two feet of water. All persons bitten at these places generally die from the bite, for the reason that the shark, living on carrion, portions of which stick between the teeth, carries infection to those whom it may afterward bite. The former habit of throwing the dead in the river is supposed to account for the boldness of these particular sharks in attacking the human species.

Self-inflicted wounds rather suggest *suicide*, as numerous instances attest, where one or two kinds of death were intended to make assurance doubly sure. I once saw an Eskimo stab himself and then jump overboard from a ship off the Siberian coast. But as a rule suicidal drowning is unaccompanied by traumatic lesions, unless it be those produced by falls. Hence the absence of lesions leads to the presumption that the individual while living fell into the water or other fluid accidentally or voluntarily.

Exception may be made in the case of infanticide and *homicidal* submersion as the result of surprise, where a person taken unawares is suddenly and unexpectedly pushed or thrown into the water. A case in point is that of a man suddenly robbed and seized by three persons, who threw him into the river. Another is that of a man who, wishing to get rid of his wife, gave her arsenic. The effects of the poison being slow he induced her to take a walk along the river, and when her back was turned he pushed her rapidly off the bank into the stream, where she drowned. Death by submersion is rarely the result of murderous intent, and in the case of adults it is suddenly resorted to in order to paralyze resistance and facilitate the success of crime.

Submersion is oftener intended to hide a crime. A body may be taken from the water after murder or rape. Whether the cadaver is recent or one that has lain in the water a long time, the expert is confronted with a question of the differences that he may expect to find in a body drowned and one thrown into the water after death. This difficulty can only be resolved by considering all the signs and lesions furnished by the autopsy. No single sign or post-mortem appearance is characteristic of drowning, and none enables us surely to diagnosticate death by submersion either in putrid or fresh cadavers. Nor do we have any significant infallible signs that may serve as a parallel between the immerged post mortem and the submerged. The exterior signs being nearly the same in the two, the diagnosis must necessarily depend upon assembled circumstances, and these are liable to vary.

CIRCUMSTANCES THAT MAY AFFECT THE TIME OF SUBMERSION.

Putrid decomposition is the chief obstacle to diagnosis in a body that has been drowned. This presents great differences. The death happening in winter or summer, in a temperate or intertropical country, and sojourn of the cadaver in salt or fresh water, are each and all important details to be considered in studying the submergence of a body.[1]

It is only by studying the events in this order, along with the immediate signs of death, that the duration of the submergence may be conjectured. With anatomical appearances as the only guide it is impossible to fix the time of immersion. Many elements combined may affect even the gaseous putrefaction that takes place in submerged bodies. Summer heat and shallow or stagnant water hasten the development of putrid gas and subcutaneous emphysema which bring the cadaver to the surface, and that, too, sometimes in spite of precautions taken to insure the submersion. A case in point is the body of the Italian admiral, Caraccioli, mentioned in Southey's "Life of Nelson." Bodies weighted with lead or other heavy substance for the purpose of hiding crime have also been known to float in consequence of the putrefactive phenomena.

At Evansville, Ind., unsuccessful efforts were made to raise a sunken steamer with thirty head of cattle between decks. A few days after the attempt was abandoned the steamer was suddenly seen to float. The carcasses of the putrefying animals, swollen by gas, had sufficed to bring the wreck to the surface.

A great development of gas is very noticeable in what is known as a "blasted" whale, the stomach of which assumes balloon-like proportions. A few summers ago, at Provincetown, Mass., it was my rare fortune to be within a few feet of an enormously distended putrid whale, which suddenly exploded.

In cold countries drowned bodies are longer in coming to the surface. In Russia, for instance, in spring after the rivers and lakes have thawed, the bodies of numerous victims of alcoholism and accidental drowning of the previous winter are taken from the water. I was present at Quebec when the body of a man drowned the winter before came to the surface of the St. Lawrence River. On a visit to the northern lakes many persons connected with the navigation of Lake Superior told me that bodies drowned in its waters seldom or never came to the surface.

Specific gravity of the water itself may be an additional cause for the body coming to the surface. Dr. Tidy says that every structure of the human body floats in the water of the Dead Sea. The same cannot be said about the buoyancy of the water of Great Salt Lake, the accounts of which have been greatly exaggerated. It does not "support a bather as if he were sitting in an arm-chair and float him like a fresh egg." Experience shows that there is no difficulty either in swimming or in sinking in its waters, the solid constituents of which are estimated to be about six and a half times more than that of sea-water. Analysis of Dead Sea water places the solid constituents at 24.580, while that of Salt Lake is 22.282. Another strong natural brine in the United States is said to be that of Syracuse Saline, New York, which contains 17.35 per cent of sodium chloride.

---

[1] The subject has been well studied by Dr. A. Carré, Archiv. de l'Anthropologie Criminelle et des Sciences Pénales, 15 Janv., 1892.

It is evident from what has been stated that no positive assertion can be made as to how soon a drowned body will rise to the surface, and at best any conclusion as to the date of submersion is so unsatisfactory that it may be said to be an unscrupulous use of guessing privileges. Errors in legal medicine are sadder in their consequences than those of medical diagnosis. The medical legist would therefore do well to preserve the frame of mind that often doubts and rarely affirms, and he should be circumspect enough to avoid dogmatic assertions about matters of uncertainty.

DETERMINATION OF SURVIVORSHIP.

BY

TRACY C. BECKER, A.B., LL.B.,

Counsellor-at-Law; Professor of Criminal Law and Medical Jurisprudence, Law Department of the University of Buffalo.

AND

JOHN PARMENTER, M.D.,

Professor of Anatomy and Adjunct Professor of Clinical Surgery, Medical Department of the University of Buffalo.

DETERMINATION OF SURVIVORSHIP.

FROM A LEGAL STANDPOINT.[1]

1. **Deaths in a Common Disaster.**—When a disaster occurs in which several persons lose their lives, questions frequently arise for the determination of the courts as to the devolution and distribution of property. In England and America (except in the State of Louisiana, which has adopted the fixed rules of the Civil Law enunciated in the Code Napoléon,[2] and in the State of California), it is now well settled that "the sur-

---

[1] By Mr. Becker.

[2] The French law is analogous to the Roman Civil Law (Code Napoléon, arts. 720, 721, 722). See article in Ir. L. T. reprinted in 14 Cent. L. J., 368, and quoted in 3 Wharton and Stillé, Med. Jur., 720, from which it appears that as now modified the French law declares that in the absence of circumstances by which the fact of survivorship may be determined, it must be decided by the probabilities resulting from the age, strength, and difference of sex, according to the following rules: If those who have perished together were under fifteen years of age the eldest shall be presumed to have survived; if all were above the age of sixty years, the youngest shall be presumed to have survived; if some were under fifteen and some above sixty the former shall be presumed to have survived; if those who have perished together were above the age of fifteen and under sixty, the male must be presumed to have survived; where there was an equality in age, or a difference of less than one year, if they were of the same sex the presumption of survivorship, by which the succession becomes open in the order of nature must be admitted;—thus the younger must be presumed to have survived the elder. These provisions are a part of the Louisiana Civil Code, arts. 936–939, and have there been construed in Gallier's Case, reported and annotated in 2 South. L. Rev., N. S., 594; s. c., 2 Woods (U. S.), 178. As stated in Newell *v.* Nichols, cited in note, p. 338, *infra*, according to the law of India, where relatives perish together it is presumed that all died at the same moment and the property of each passes to his living heirs without any portion of it vesting in his companions in misfortune. And according to the Civil Code of Holland (sec. 878), in the absence of evidence the presumption is that all persons die together at the same moment, and that there is no transmission or succession from one in favor of the other. See also Austrian Civil Code, 25. The same rule, slightly modified, has been adopted in California Code of Civil Procedure, sec. 1963, subdiv. 40. Sanders *v.* Simcich, 65 Cal., 50; Hollister *v.* Cordero, 76 Cal., 649; and see Vol. 24, "Am. and Eng. Enc. of Law," tit. Survivorship; Second Edition, Vol. 22, p. 1251, tit. Presumptions. Diligent examination does not disclose any statute in any other of the United States on the subject, probably because the rule of the common law as laid down by the courts is satisfactory.

vivorship of two or more persons must be established by the facts, and not by any arbitrary rule or prescribed presumption."[1]

The rule of law deducible from the cases in England and America cited in the notes cannot be better or more clearly stated than it has been by Chief-Justice Church in Newell *v.* Nichols, 75 N. Y., 89, 90, as follows:

"The rule is that the law will indulge in no presumption on the subject. It will not raise a presumption by balancing probabilities, either that there was a survivor or who it was. In this respect the common law differs from the civil law. Under the latter, certain rules prevail in respect to age, sex, and physical condition, by which survivorship may be determined, but nothing can be more uncertain or unsatisfactory than this conjectural mode of arriving at a fact which from its nature must remain uncertain, and often upon the existence of which the title to large amounts of property depends. In the language of the Lord Chancellor in Wing *v.* Underwood (4 DeGex, M. and G., 633): 'We may guess, or imagine, or fancy, but the law of England requires evidence.' There are cases where a strong probability in theory at least would arise that one person survived another, and perhaps as strong as that, that there was *a* survivor, and yet the common law wisely refrains from acting upon it in either case. It is regarded as a question of fact to be proved, and evidence merely that two persons perished by such a disaster is not deemed sufficient. If there are other circumstances shown tending to prove survivorship, courts will then look at the whole case for the purpose of determining the question, but if only the fact of death by a common disaster appears they will not undertake to solve it on account of the nature of the question and its inherent uncertainty. It is not impossible for two persons to die at the same time, and when exposed to the same peril, under like circumstances, it is not as a question of probability very unlikely to happen. At most the difference can only be a few brief seconds. The scene passes at once beyond the vision of human penetration, and it is as unbecoming as it is idle for judicial tribunals to speculate or guess whether, during the momentary life-struggle, one or the other may not have ceased to gasp first, especially when the transmission of title to property depends upon it, and hence in the absence of other evidence the fact is assumed to be unascertainable, and property rights are disposed of as if death occurred at the same time. This is done not because the fact is proved, or that there is any presumption to that effect, but because there is no evidence and no presumption to the contrary. The authorities are uniform upon this doctrine, but the expressions of some of the judges in announcing it are liable to be misunderstood as indicating a presumption of simultaneous death which is not the rule. For instance, Sir William Wynne said: 'I always thought it the most natural presumption that all died together, and that none could transmit rights of property to another.'[1] Sir John Nicholl said: 'I assume that both perished in the same moment.'[1] In the Matter of Selwyn,[2] the Court said: 'But in the absence of clear evidence it has generally been taken that both died in the same moment.' Sir Herbert Jenner said: 'The parties must be presumed to have died at the same time.'[3] These expressions only mean that as the fact is incapable of proof, the one upon whom the *onus* lies fails, and persons thus perishing must be deemed to have died at the same time, for the purpose of disposing of their property. The Lord Chancellor in Wing *v.* Underwood (*supra*) recognized the distinction, and explained the meaning of the rule. In commenting upon a similar expression of the Master of the Rolls to the effect that he must assume that Mr. and Mrs. Underwood both died together, the Chancellor said: 'From personal communication with his Honor I know that he is not aware that he ever used such an expression, and all he ever meant to say was that the property must be distributed just as it would have been if they had both died at the same moment.' And Mr. Best, in his work on Presumptions, after laying down the general rule, states that it is not correct to infer from this that the law presumes both to have perished at the same moment, and adds: 'The practical consequence is, however, nearly the same, because if it cannot be shown which died first, the fact will be treated by the tribunal as a thing unascertainable, so that for all that appears to the contrary both individuals may have died at the same moment. All the common-law authorities are substantially the same way, and the rule, which I think is wise and safe, should be regarded as settled.'"

---

[1] Per Van Vorst, J., in Newell *v.* Nichols, 12 Hun (N. Y. Sup. Ct.), 604–611, affirmed 75 N. Y. Ct. App. Rep., 78. The King *v.* Dr. Hay, 1 W. Bl., 640; s. c., 4 Burr, 1295; General Stanwix Case, referred to in the medical text below (an example of futile speculation); Doe *v.* Nepean, 5 B. & Ad., 91, 92; Taylor *v.* Diplock, 2 Phillimore, 261; Colvin *v.* Procurator General, 1 Hagg. Ecc. R., 92; Matter of Goods of Selwyn, 3 *id.*, 748; Matter of Goods of Murray, 1 Curt., 596; Satterthwaite *v.* Powell, *id.*, 705; Mason *v.* Mason, 1 Meriv., 308; Underwood *v.* Wing, 19 Beavan, 459; s. c. on appeal before the Lord Chancellor, 4 DeG., M. & G., 633; s. c. (under name of Wing *v.* Angrave) in the House of Lords, 8 H. of L., 183; 30 L. J. Ch., 65; Elliott *v.* Smith, L. R., 22 Ch. Div., 236, criticised in 27 Solicitor's Journal, 49, article entitled "Death of Several Persons Dying by a Common Calamity." And see also Wollaston *v.* Berkley, 2 Ch. Div., 213; 34 L. T., N. S., 171; 24 W. R., 360; 45 L. J. Ch., 772; *Re* Wainwright, 1 Sw. & Tr., 257; Scrutton *v.* Pattillo, L. R., 19 Eq., 369; *Re* Ewart, 1 Sw. & Tr., 258; *Re* Grinstead, 21 L. T., N. S., 731; *Re* Nichols, L. R., 2 P. & D., 361; *Re* Carmichael, L. R., 32 P. & A., 70; *Re* Wheeler, 31 L. J. P. & M., 40; *In re* Green, L. R., 1 Eq., 288; *In re* Phene, 5 Ch. App., 139; *In re* Lewis, L. R., 11 Eq., 236, all of which follow the rule laid down in Underwood *v.* Wing, *supra;* 2 Best on Evidence, 187; *ibid.*, Am. Ed. (13th ed.), sec. 30, n. 2; and see also the following American cases: Coye *v.* Leach, 8 Metcalf (Mass.), 37; Smith *v.* Croom, 7 Fla., 81, 180; Pell *v.* Ball, 1 Cheves Eq. (S. Car.), 99; Vol. 3, N. Y. Legal Obs., p. 269; Moehring *v.* Mitchell, 1 Barb. Ch., 270; Stinde *v.* Ridgway (N. Y. Sup. Ct., Sp. Term, 1878), 5 How. Pr. Rep., 301; Freeman *v.* Kellogg, 4 Redf. Surrogate's Ct. Rep. (decided by Calvin, Surrogate, in 1880), 218; Southwell *v.* Gray, 35 Misc. (N. Y.), 740; Russell *v.* Hallett, 23 Kans., 276; Ehles Estate, 73 Wis., 445; Wentworth *v.* Wentworth, 71 Me., 72; Johnson *v.* Merrihew, 80 *id.*, 111; *Re* Hall (Illinois), 9 Cent. L. J., 381; Balder *v.* Middeke, 92 Ill. App., 227; Fuller *v.* Linzee, 135 Mass., 468; Cowman *v.* Rogers, 73 Md., 403; Paden *v.* Briscoe, 81 Tex., 563; Cook *v.* Caswell, *id.*, 678; *Re* Willbor, Petitioner, 20 R. I., 126; Kansas Pac. Ry. Co. *v.* Miller, 2 Col., 442; Hartshorne *v.* Wilkins, 6 Nova Scotia R., 276; all of which cases substantially follow the English common-law rule as expounded in England in Underwood *v.* Wing, and New York State in Newell *v.* Nichols.

---

[1] Rex *v.* Heass, 2 Salk., 593; 2 Phill., 296, note c.; 5 B. & Ad., 91, 92.

2. **Expert Medical Testimony in Cases of Death in a Common Disaster.**—Since no legal presumption of survivorship in a common calamity arises from age, strength, or sex, may there be given expert testimony as to probable survivorship, which is based upon these circumstances, or upon the state of health of the persons deceased? In the absence of clear decisions, the answer undoubtedly is that such evidence would be inadmissible, because too speculative and conjectural.[4] Neither the court nor a medical witness should guess whether

---

[1] Taylor *v.* Diplock, 2 Phill., 261.

[2] 3 Hagg. Ec. R., 748.

[3] Satterthwaite *v.* Powell, 1 Curt., 705.

[4] *Cf.* Briggs *v.* N. Y. C. R. R. Co., 177 N. Y., 59; Paty *v.* Martin, 15 La. Ann., 620.

the common cause of death would operate more speedily upon one person than another. A case is almost unimaginable where expert testimony could in such a case demonstrate a real probability of survivorship. When, however, other data are available, as, for example, the results of examination of the dead bodies, a proper case for the introduction of expert testimony may be presented. See on this the second part of the present article.

3. **Survivorship of Persons Who Have Disappeared.**—When a person disappears, and the question arises whether he has survived some other person the time of whose death is known, expert testimony may be given of his physical condition about the time of disappearance, and the probable subsequent duration of his life. Such opinion evidence, if offered to prove his death, must, however, be so conclusive as to create a reasonable certainty.[1] Otherwise, there would here also be no presumption.

---

[1] Cambrelleng *v.* Purton, 125 N. Y., 610; Butrick *v.* Tilton, 155 Mass., 461; Hornberger *v.* Miller, 28 App. Div., 199; aff'd, 163 N. Y., 578; Webster *v.* Birchmore, 13 Ves. Jr., 362.

FROM A MEDICAL STANDPOINT.[1]

It is the intention of the writer to keep the medical distinct from the legal view of the subject, except in so far as reference to legal cases may be necessary to illustrate and emphasize the points under consideration.

The writer wishes to emphasize the belief that the question of survivorship cannot in the present state of medical knowledge, and from the inherent difficulties of the subject, be treated in a dogmatic and positive manner. As will be seen, the conditions which affect such cases are so variable that positive general conclusions cannot be drawn, and each case must be decided upon the evidence obtainable in such case. In short, the determination of survivorship requires the recognition and accurate interpretation of certain conditions which, singly or combined, produce a given result. Modify a single condition, or the combination, and an entirely different result is obtained, so that in proportion as the conditions vary, the conclusions become either speculative or unattainable, and of little or no probative force.

Given a case where two or more persons have met their death by a common accident; what are some of the conditions which, rightly interpreted, may aid in determining to a reasonable certainty the question of survivorship?

1. **Degree of Danger.**—It is so obvious that the greater the danger the more likely is the effect to be lethal, that nothing further need be said. In the matter of an injury, the more vital the region injured the more dangerous is such injury, and this regardless of the extent and other characteristics of it in many cases. Thus, an apparently insignificant puncture of the abdominal wall may occasion death, where an extensive lacerated wound of the thigh, or even loss of that member, would not seriously jeopardize the life of the individual so injured. The degree of danger, therefore, depends upon factors differing in kind, and each of which must be given consideration and assigned its exact rôle in each case.

---

[1] By Dr. Parmenter.

2. **Age.**—The real importance of age, *per se*, in questions of survivorship is not easy to measure. It is so intimately connected with the mode of death that it is often difficult, and even useless, to consider them separately. This is particularly so in the case of adults. It is commonly and probably correctly assumed that between the ages of twenty-five and fifty years, the power to withstand lethal agencies is practically the same, so far as age alone is concerned. Further, that, in adult life, the individual has greater powers of resistance than in youth or old age. However, here, as elsewhere, we can find exceptions to this in, for instance, the greater power of children than of adults to withstand heat and thirst. In one case, say severe injury with hemorrhage, youth would predispose the individual to earlier death than the adult; in the other case, say extreme heat or prolonged thirst, youth would act to give it an advantage over maturer years. Thus, we have an exemplification of what has been previously asserted, viz., that when conditions vary so greatly, our conclusions may be erroneous, unless carefully made, and we can more readily understand how other coincident conditions may be so closely related to age that they must be reckoned at the same time.

3. **Sex.**—It is commonly presumed, that the male, being stronger than the female, will survive longer than she. Strength, however, must not be confounded with endurance, and perhaps more often the possession of the latter is most useful in preserving or prolonging life, when threatened. In the matter of endurance, women have demonstrated over and over again their ability to withstand the severest physical ordeals, and it is certainly a debatable question, whether they have not in the main even more resistance than man. This seems, indeed, clearly established in some causes of death, as we shall see later on. Sex, like age, is closely related to other conditions, and, like the latter, must often be considered with them to ascertain its full import.

4. **Constitution.**—Obviously, a delicate constitution must yield sooner than a strong one, for strength and endurance are less quantitatively and qualitatively. Again, the form of weakness and the cause of death may be such as to unite in bringing about an earlier fatal issue than would be the case were the cause of death different. For instance, an individual suffering

from some disease, producing embarrassment of respiration, would succumb to suffocation sooner than a person equally weak in every other respect but from some other trouble in which the respiration was only relatively affected. Indeed, age, sex, and constitution are scarcely separable in questions of survivorship and must usually be considered in relation to each other to give each its due share of influence. A good illustration of this is the well-known Stanwix case.[1]

"In 1766, General Stanwix and daughter set sail in the same vessel from Ireland for England. They were shipwrecked, and not a single person on board was saved. The representative of the personal estate of the father was the nephew, and the representative of the daughter was her maternal uncle. These parties brought the case into Chancery. On behalf of the nephew whom the general's survivorship would benefit, it was argued, that the ship being lost in tempestuous weather, it was more than probable that the general was upon deck, and that the daughter was in the cabin, and subject to more early loss of life than the general, who, as a man of arms and courage, was, it was asserted, more able and more likely to struggle with death than a woman. Further, it was argued that he might probably have been assisted in his struggles by the broken masts and other parts of the rigging. On the other side it was contended that the general was old, and consequently feeble, and by no means strong enough to resist the shock of such a terrible attack, while the daughter was of a hale constitution, and, being younger than her father, was proportionately stronger. It was contended therefore that the probability of survivorship was infinitely in favor of the daughter. A second wife of General Stanwix also perished with him, and her representative brought forward a separate claim to the disputed property. The Court, finding the arguments on all sides to be equally sound and ingenious, waived giving any decision, and advised a compromise, to which the several claimants agreed."

5. **Mode of Death.**—Of the many ways in which death may come to persons, a few are sufficiently common to not infrequently require consideration on the question of survivorship.

(*a*) DROWNING.—Where the bodies are recovered, examination of them may make it clear which one survived the others.

---

[1] Beck, 1860, Vol. i., p. 643. See the legal treatment of this question, *supra*, p. 338.

Where no recovery has been made, known ability as a swimmer of some one of those drowned, age, sex, constitution, and position at the time of accident, in case of shipwreck, will be the factors meriting inquiry. Thus, in a sinking ship, those on deck have an advantage over those in the cabin; again, men, being less timid than women, are more apt to be on deck, and having the advantage in the matter of dress and muscular strength, could in such a case make a better fight for life. The position of the bodies at the time of recovery is also of importance. Positions suggesting efforts to save others favor the presumption of their survivorship. The presence of injuries in and of themselves serious, when found upon the bodies of those drowned, may kick the balance against the probable survivorship of some one apparently favored by the other conditions. For instance, given two persons thrown into the water, the one a good swimmer and otherwise physically strong, the other inferior in every respect. The former strikes with his head upon some hidden object and is rendered unconscious immediately and speedily drowns. In such a case, the latter survives the longer and with the majority of advantageous conditions against him. Injuries may have a different meaning. They may have been caused by the efforts to ward off death, under which circumstances they would indicate survivorship over those whose bodies bore no such evidences. Again, the character and amount of clothing, the power to resist cold, the presence of available wreckage upon which to cling, and many other circumstances peculiar to a given case could come into play to aid in the solution of the question.

(*b*) SUFFOCATION.—Among the conditions already enumerated, two are of especial importance in this connection. They are, position of the body, and the presence or absence of wounds. Of a number of men suffocated under the debris of some fallen structure, the one who is nearest the surface and upon whose body are the fewest and most trivial wounds, and other evidences of injury, is in all probability the one who died last. This was exemplified in a case quoted by Tidy,[1] where it is related that a large sugar warehouse, having its floors unduly strained, collapsed, burying the workmen in the ruins. The men were found dead in proportion as the debris was cleared away. Those nearest the top escaped with injuries more or less severe; while those working on the second and ground floors were for the most part dead. Whether or not additional injuries, due to the increased weight of the debris, were present and contributed to the death of the victims, the report does not say. The inference is, that death was due to suffocation and not to coincident injury.

---

[1] Brit. and For. Med.-Chir. Rev., p. 189.

(*c*) ASPHYXIA FROM IMPERFECT VENTILATION OR FROM POISONOUS GASES.—Among other things must be noted, testimony regarding toleration from long exposure to certain gases in dilute form, as in the case of workmen in certain employments; the position of the bodies in connection with the specific gravity of the gas and their proximity to its source, and the vigor and sex of the parties.

Concerning the vigor of a person as an advantage in threatened death from asphyxia, Tidy makes the following significant observation, that while vigor and muscular strength may help a person to reach a place where most oxygen is to be found, this demand for and effort to obtain air is probably in proportion to its want, while the want is rendered greater by the intensity of the effort, and that inactivity may in the long run be of decided advantage to persons threatened with asphyxia.

Regarding sex in this connection, it is noteworthy, that many cases are recorded where a man and a woman have been exposed at the same time to similar deadly gases, with the result that the evidences were unmistakable of the survival of the woman beyond the time of death of the man. This is possibly due to the fact that women consume less oxygen than men and can therefore exist longer in an atmosphere containing a minimum amount (relatively speaking) of oxygen than can men. Proximity to the place from which most air can be obtained is probably the most important factor in determining survivorship in cases of asphyxia, and evidences of possible air-supply should always be sought for.

(*d*) STARVATION.—Age, constitution, adipose, and the use or non-use of water are the principal factors to be considered. The aged, requiring less food than adults, can survive longer without it. The same is true of adults as compared with children. Again, women consume less food than men, and hence bear starvation better and longer. The fatter the body, the longer it can live upon itself; hence, other things being equal, the fat can outlive the lean. The ability to live many days (thirty and more) upon water alone makes it important to know whether or not water has been obtainable. Of two persons, one denied both food and water and the other food only, the latter would most surely survive the former.

Again, as in the case of threatened death from asphyxia, passive exercise or inactivity is advantageous, for the reason that in this way tissue-change is less rapid, and hence the resources of the body are economized. When food is given but water denied, children seem to bear the loss of the water better than adults.

(*e*) COLD.—Other things being the same or equal, adults bear cold better than the young or the old, and men better than women. Important modifying circumstances may come into play, however, such as the amount and kind of clothing, the stoutness of the individuals concerned, and the state of nutrition, habitual addiction to alcoholic or other stimulants or the use of narcotics, prior to the exposure to cold. The advantage of clothing and fat in keeping out the cold and in retaining the warmth of the body is obvious. Again, half-starved or overstimulated tissues with the concomitant lessened nervous force, and tissues already benumbed by some narcotic, are easily overcome by cold.

(*f*) HEAT.—The effect of heat upon the young and old demonstrates their superior resistance to it as compared with that of adults. In the case of children, for instance, we commonly see them recover from diseases attended with a temperature so high, that did it occur in an adult it would usually mean death. In a similar way they bear heat from external sources, if it be dry and unattended with loss of cutaneous surface. In the writer's experience, severe scalds or burns, in the case of children, where the skin has been damaged over a considerable area, are often rapidly fatal, causing death in twenty-four hours, where a similar extent of injury (relatively) in an adult would not cause death until the fifth or sixth day. The nervous system in childhood is much more impressionable and not so resistant of shock, and hence, probably, the greater fatality of burns in that period of life.

(*g*) ELECTRICITY (INCLUDING LIGHTNING).—The increasing use of electricity in one form or another makes death from this source of more or less common occurrence. Presumably the general tone and vigor of the body increase its resistance to the effects of this agent, but upon this subject we have as yet much to learn. Conditions to be estimated are the completeness of the circuit and the voltage, the degree of moisture, the condition of the clothing, whether torn or not, and the state of metallic substances carried about the person, whether fused and rendered highly magnetic.

(*h*) POISONING.—Several factors need to be considered; among which are the state of the health of all concerned at the time of exposure to the effects of the poison, the age, known idiosyncrasies, the kind of poison and the amount ingested. The question as to what constitutes a lethal dose of a given poison not infrequently arises, and is often exceedingly difficult to answer, because of the varying tolerance of individuals who are apparently similar in a physical sense. Age too has its influence in certain cases; for instance, children have a relatively great tolerance for belladonna, and this circumstance might go far to offset the many disadvantages incident to tender years and permit the child to survive a much older person who may have been similarly poisoned at the same time. Furthermore, it is to be ascertained if any evidence exists of addiction to a drug to such an extent as to cause a habit. It is a matter of common observation that the body soon becomes tolerant of drugs (opium, arsenic, strychnia, etc.) in doses which are ordinarily lethal, and hence the ability to withstand their effects for a longer time than in the case of those not having the advantage of previous tolerance is to be presumed. Obviously then, given two persons to whom have been administered lethal doses of opium, that one who has been accustomed to the drug will long survive the other.

(*i*) DEATH BY PARTURITION.—When mother and child die during parturition and there have been no witnesses of such death, the presumption is strong that the mother has survived the child. The child should be examined for such evidences as would indicate still-birth, and the mother for any signs predisposing the child to the same; breech presentation, large head, prolapsed cord, lungs void of air, indicating that the child has never breathed. Then it must not be forgotten that at such time the mother could give but little assistance in helping to preserve the child's life. All these circumstances make it presumable that the mother outlives the child. On the other hand, the possibility must be borne in mind that a mother attempting to tie the cord of her child, and care for it in other ways, may die from the effort necessary to do this.

Some years ago a case came under the personal observation of the writer which fairly well illustrates this possibility: a vigorous and opinionated young woman from motives of economy did not secure the services of either a physician or a midwife at the birth of her fourth child. After tying the cord, she was seized with a violent and alarming hemorrhage, which might easily have terminated her life except for the timely assistance of a cool-headed and intelligent neighbor until medical aid was secured. (See POST-MORTEM PARTURITION, Vol. II., p. 369 *et seq.*)

6. **Position.**—This is so often related to other conditions, as we have already seen, that little more need be said. It is of great importance to ascertain all the significance that position may possess, as it often affords a most important link in the chain of evidence. That body found nearest a source of intense heat or a poisonous exhalation, or farthest from the surface where air is obtainable, in all probability died before one more advantageously situated, and so cases might be multiplied in which the point of vantage would presume the survivorship of the one possessing it. It must be remembered, however, that such position may imply earlier death from the very efforts necessary to obtain it, and, hence, position alone should not make the sole basis from which our inferences are to be drawn.

7. **Stage of Putrefaction.**—In the case of bodies recovered some time after death, the various stages of putrefaction noted may aid in determining a question of survivorship. This requires a knowledge of these stages and of the time necessary for their development under ordinary conditions. Furthermore, modifying circumstances must be understood and their rôle correctly estimated. Among these are the media in which the bodies lay, whether dry or moist, warm or cold, the amount of adipose, the existence of disease and its nature prior to death, the habits in the matter of alcohol of the individual, the age,

kind of death, etc., all of which modify in more or less degree the putrefactive process and cause deviations from the normal, if, indeed, there be any standard which may be so designated.

8. Time of Death.—Where the exact time of death of one of two or more persons and that of the other or others is only presumptive, the evidence obtainable must influence the decision. Illustrative of this is the often-quoted case of Hugh Swinton Ball,[1] summarized by Tidy as follows: "On June 14th, 1838, Hugh Swinton Ball, his wife, and adopted daughter were lost on board the steamer *Pulaski* off the coast of America. An explosion took place at 11 P.M., the husband and wife being in different parts of the vessel. Mr. Ball *was not seen after* the explosion, although the exact time of his death was not known. Mrs. Ball *was seen afterward*, rushing about frantically, and calling for her husband. She was soon missed, however, the deck where she was going under water; all were lost. By will Mr. Ball had left his property to his wife, and her heirs now claimed it on the ground that she survived her husband. The defendants argued that as the time of the wife's death could be fixed, while that of the husband's could not, it was fair to presume that she died first. Chancellor Johnson decided for the plaintiffs (viz., that Mrs. Ball survived her husband). He admitted the *onus* was on the plaintiffs to prove that she survived, but he considered the fact that Mr. Ball did not appear after the explosion, while his wife was seen and recognized, was sufficient. On appeal this decision was affirmed." (See TIME OF DEATH, Vol. I., p. 919 *et seq.*)

Indeed, the whole subject contains many inherent and often insurmountable difficulties which only the growth and development of science can remove. Fortunately, thus far the question of survivorship in respect to several persons found dead together has been one of great rarity, and the opportunities few and far between of applying our knowledge of medical science toward its solution.

---

[1] American Journal of Medical Sciences, July, 1845.

FORENSIC MEDICINE.

BIO-THANATOLOGICAL.

ABORTION AND INFANTICIDE.

BY

J. CHALMERS CAMERON, M.D., CM., M.R.C.P.I., Etc.,

Consulting Physician, Montreal General Hospital; Professor of Obstetrics and Diseases of Infants, McGill University, Montreal; Physician Accoucheur, Montreal Maternity Hospital.

ABORTION AND INFANTICIDE.

GENERAL CONSIDERATIONS.

MEDICO-LEGALLY, *abortion* means the premature expulsion of the product of conception, either as ovum, embryo, or fœtus. *Criminal abortion* means criminal interference with the course of gestation, so as to cause the premature expulsion of ovum, embryo, or fœtus. *Fœticide* means destroying the life of the fœtus before it is fully born and has a separate existence from its mother. *Infanticide* means destroying the life of a newly born child which has a separate existence from its mother. The overlapping of these terms leads to more or less confusion. Criminal abortion does not necessarily imply fœticide or infanticide; for if a viable child is born alive though premature, and no attempt is made upon its life after birth, criminal abortion may have taken place without either fœticide or infanticide. Then again fœticide or infanticide does not necessarily imply criminal abortion, for the premature expulsion of the fœtus may be due to natural causes, and criminal attempts may be made upon its life during or after its birth; or again criminal abortion may coexist with either fœticide or infanticide. Much confusion has arisen, too, from the different replies given to the question "Fœtus or child?" In a case of still-birth (asphyxia neonatorum), the child being completely born, its heart beating, but as yet no attempts at respiration—is the product of conception only a *fœtus* dependent upon its mother for life, or is it a separate being, an *infant* in the legal sense of the term? Prompt treatment might establish respiration and the child might live; delay or neglect might permit it to perish without having breathed. Would criminal action (whether active or passive) toward such a child be *fœticide* or *infanticide?*

Much popular confusion has arisen from erroneous notions respecting the time when life begins in the fœtus. Hippocrates made it the thirty-second day for the male, the forty-second for the female. Galen placed it at the fortieth day, while many held that the fœtus does not become a living creature till the hour of its birth.[1] The general opinion among the ancients seemed to be that the fœtus is a part of its mother until the time of its birth, when it acquires the nature and rights of a separate being. The mother had the same right to destroy it before birth as she would have to remove a tumor from her body. The Stoics taught that it received its soul with the establishment of respiration. The Justinian code fixed its animation at forty days after conception. In modern legislation, the human embryo is treated as a distinct being from the moment of conception, so that legally as well as physiologically life is postulated from the moment of impregnation. It is no longer considered as a "pars viscerum," in an anatomical or clinical sense.

Confusion has also arisen in some countries from different interpretations of the term *new-born*. How long may a child be considered new-born? When does the taking of its life cease to be infanticide and become murder? In 1824, Werner defined a child as *new-born*, so long as it is neither fed nor clad, while the mother still labors under the immediate consequences of delivery, and while no one but herself, her parents, and its father know of its birth. The Oldenburg statute-book[2] defines a new-born child as one not yet three days old. According to the old statute-book of Wurtemberg and Saxony, it is one not over twenty-four hours old. The present German and Austrian statutes define new-born as "in or immediately after birth" (German, in oder gleich nach der Geburt; Austrian, während oder gleich nach); the Italian as "un infante di recente nato." In France the law defines infanticide as the murder of a new-born child; and Ollivier says a child is new-born up to the fall of the cord (fifth to sixth day).[3] The question has not been raised in England.

Another question has been before the courts in Germany, which does not seem to have been raised in England or America: Can a *mole* be considered a product of conception, and can an accusation of criminal abortion hold in such a case?[4]

---

[1] Lecky's "History of European Morals," 3d ed., vol. i., p. 92; *cf.* also vol. ii., pp. 20–28.

[2] Casper-Liman, Bd. ii., 8te Aufl., 878–9.

[3] Bouchut: "Maladies des Nouveau nés," 8th ed., p. 1.

[4] Casper-Liman, Bd. ii., 877–8. A hydatid mole is undoubtedly a degenerate product of conception, and its presence denotes the existence of pregnancy. Whether the law in this country would characterize the expulsion of a mole as abortion has not been determined.

ABORTION.

In considering a case of alleged abortion, four main questions suggest themselves:

1. Has abortion taken place?
2. If so, was it *spontaneous* (from natural causes), or *induced* (by the intentional act of the mother or any other person)?
3. If intentionally induced, was the act justifiable or criminal?
4. Did the induced abortion injure health or destroy life?

A fifth question may arise in some cases: Does the fact of non-pregnancy invalidate a charge of criminal abortion? Hofmann relates the case of a woman who was not pregnant, but believing herself to be so adopted means to procure an abortion. It was held that, although abortion could not take place in a non-pregnant woman, yet the penality of the attempt was not excluded, and the attempt was held punishable whether the completion of the act was possible or not.[1]

A case of this kind was tried a few years ago in Chicago. A girl died from metro-peritonitis, and a midwife was accused of causing her death by an attempt to induce abortion. The post-mortem showed that abortion had undoubtedly been attempted, but the girl had never been pregnant.[2]

It has been held also that a punishable offence was committed when an attempt was made to induce abortion, (1) although the measures employed were unsuitable, (2) although the fœtus was actually dead and macerated when the attempt was made, (3) although the fœtus was not in the uterus, but outside of it (extra-uterine gestation).

DIAGNOSIS OF ABORTION.

The diagnosis of abortion is based upon:

1. The examination of the mother herself;
2. The examination of discharged matters,

and is generally easy if both methods of examination are available. Unfortunately, in most cases only the mother can be examined, and not until some time after the occurrence of the abortion.

---

[1] Hofmann, 9th ed., p. 210.

[2] Brit. Med. Jour., Sept. 16, 1882, p. 504.

The relative ease or difficulty of diagnosis depends very much upon how soon and thoroughly the examination is made.

Examination of the Mother.

The conditions present will depend upon the period of pregnancy, and the time which has elapsed since the abortion. In the earlier months, the appearances are seldom conclusive enough to warrant a positive diagnosis. Severe hemorrhage, the passage of large blood-clots, subsequent pallor and weakness may arouse suspicion, but may occur from so many other causes (*e.g.*, polypi, tumors, membranous dysmenorrhœa) that no positive conclusions can be drawn. The ovum is so small that the genital tract is not stretched or injured by its passage as in the later months. The further pregnancy advances, the larger the fœtus becomes and the more pronounced the stretching and wounding of the uterus and vagina by its extrusion. Abortions at the fourth to seventh month leave marks differing only in degree from those observed at full term, but fissures and lacerations of the os and cervix are proportionately rarer than after labor at full term. The changes in the hymen and the formation of carunculæ myrtiformes are not so well marked as at full term. If marks of instrumental or other violence can be made out, the probability of criminal interference is great. If the woman is dead and a careful post-mortem examination of the uterus and parturient canal can be made, the diagnosis is generally easy, provided putrefaction is not too far advanced.

If the accused denies pregnancy, it may be necessary to prove by the medical examination that pregnancy has existed recently, and that delivery has taken place either prematurely or at full term.[1] Or she may admit pregnancy, but claim that she was delivered naturally at full term or some time previously; it may be necessary then to establish the fact of premature delivery or recent delivery. Practically the difficulty of diagnosis is increased by the fact that most criminal abortions are induced in the first three months of pregnancy, when no definite or positive traces may be found, especially if the woman is alive and some days have elapsed since the abortion took place. The use of instruments by ignorant and unskilful persons is very apt to injure the parts, so that a careful examination made subsequently will reveal the existence of recent traumatisms or fresh cicatrices. But nowadays since the proper use of gynæcological instruments is so well understood even by the laity, instrumental abortion is commonly induced without leaving incriminating wounds. Dr. Resnikow,[1] a Russian physician, reports a case of abortion which he was called to attend in Odessa. The mother had borne three children. Three years previously she had successfully brought on abortion by passing a flexible rubber sound, and now for the second time she had resorted to similar means. When seven or eight weeks pregnant, she began passing a sound into her uterus every day; finally she left it *in situ* till pains set in and then removed it. She used a No. 16 sound, and disinfected it carefully in two-per-cent carbolic acid solution each time before passing it. She said she had learned how to pass it from a midwife, and showed Dr. R. how she did it. In this case it would have been impossible to determine by physical examination whether the abortion was natural or artificial.

---

[1] See Pregnancy, Labor, etc., this vol., pp. 505–623.

Goenner reported a remarkable case of self-induced abortion. A multipara æt. 37, two months pregnant, passed an elastic catheter, whose anterior half had been cut off, into the vagina by means of the stylet. She suddenly felt pain, and thinking that the catheter had entered the cervix, withdrew the stylet. Some blood flowed, and symptoms of fever and peritonitis soon began. She aborted six days afterward, but the catheter did not come away nor could it be found. A couple of months later it was passed from the bowel, coated over with mucus. The question is whether the catheter entered the uterus or abdominal cavity, and how it managed to get into the intestinal canal. The patient was a married woman, and there was no attempt at concealment. She had already succeeded on three previous occasions in procuring abortion with a similar instrument, and when she found that something was wrong immediately sought advice and was under observation throughout.[2]

EXAMINATION OF DISCHARGED MATTERS.

If all clots and discharges have been saved, and can be examined within a few days of their discharge, there should be little difficulty in determining the presence of an ovum or ovular structure. The older the ovum, the easier is its detection. All clots should be examined under water; the blood is thereby washed away and a complete ovum sometimes found. In the first two or three months it is frequently expelled entire; but after the formation of the placenta the membranes usually rupture, the embryo is expelled, and the placenta comes away subsequently (hours, days, or even weeks). The placenta may not come away at all, but may have to be removed artificially.

---

[1] Centralblatt f. Gyn., No. 44, 1893, p. 1,016. [2] *Ibid.*, No. 3, 1894, p. 68.

Finding the embryo is not essential for the diagnosis of pregnancy or abortion; any of the distinctly fœtal structures suffice, such as the placenta, amnion, chorion, or chorionic villi. The decidua being a maternal structure is not positively diagnostic, because it is not always distinguishable from a menstrual or pathological decidua of the non-pregnant state. If portions of membrane only are available, they should be examined microscopically; a simple macroscopic examination is open to many fallacies and is, therefore, untrustworthy.[1] If the complete ovum can be examined, an idea may be formed of the age of the embryo and the period of gestation. Such an idea, however, is only approximate, as the embryo may have perished some time before it was expelled. Indeed it is possible for the embryo in the first two months to perish and be absorbed.

Again, disease of the fœtal or maternal structures may arrest or pervert the growth of the ovum, so that no satisfactory conclusion can be drawn from the size or appearance of the embryo as to the period of pregnancy. In such cases, however, the maternal or fœtal structures will show evidences of disease which are easily recognizable. A healthy ovum in healthy surroundings will follow the ordinary plan of development; it is only the unhealthy ovum in unhealthy surroundings which varies from the normal type, and the microscope readily enables us to detect the pathological conditions which caused the variation.

In exceptional cases the fœtus perishes and remains quite fresh in the uterus for weeks or even months, until it is finally discharged. A remarkable case in this connection is that of Liégey,[1] where a woman claimed on this ground that a six-months fœtus belonged to her eleven-months-dead husband. Another remarkable case was reported by Kleinertz of Stuttgart, where the child died two months before the end of gestation, and was retained in the uterus three months after, making a retention of 5½ months after its death. It was finally removed by Cæsarean section.[2] If an ovum has been lying for some time in earth or water (as in a closet or privy), or if decomposition is far advanced, it may be difficult to form an opinion respecting its age. Minute descriptions of the appearance of the ovum at the various periods of its growth can be found in any of the recent works on embryology; it will suffice here to give very briefly the size of the embryo at the various months.[3]

---

[1] Early abortions (1–2 months) can be affirmed if portions of the ovum are found. The presence of chorionic villi is decisive. Even in their absence, if syncytial giant cells are found among decidual cells, or glands with proliferation of epithelium in the deep decidual layer, the differential diagnosis must be made from submucous myomata and from decidua menstrualis. In the latter there is absence of the typical decidual cells and the syncytial giant cells, as well as of the great enlargement of the vessels. In more advanced pregnancies, especially in primiparæ, in the absence of an embryo, the diagnosis is made from changes in the breasts and abdominal wall, the signs of uterine involution, fissures about the os uteri, and roughness of the placental site.

At end of **First month:**[4] Ovum size of pigeon's egg, 1.7–2 cm. long; chorionic villi equally distributed over the whole surface. Embryo 1 cm. long; attached to chorion with a very short cord; strongly curved; nose and mouth form a single cavity; umbilical vesicle still present; extremities evident as buds or small excrescences.

Second month (eighth week): Ovum size of hen's egg. Embryo 2.5–3 cm. long; weighs 4 grammes. No longer curved; cavities of mouth and nose separated; umbilical vesicle disappeared; extremities developed but not fingers and toes; cord longer; ossification begun in lower jaw, clavicle, ribs, and bodies of vertebræ.

Third month (twelfth week): Ovum size of goose-egg. Placenta developed. Fœtus 7–9 cm. long, weighs 5–30 grammes. Fingers and toes developed; sex begins to differentiate; ossification in cranial bones and diaphyses of the extremities; average weight of placenta, 36 grammes; average length of cord, 7 cm.

---

[1] Virchow, Jahrb., 1881, i., 533. Consult also articles on *missed abortion* and *concealed abortion* in the larger obstetrical works.

[2] Centralblatt f. Gyn., 1901, p. 809. See also Archiv. de Gyn. et Toc., March, 1896, p. 213, a case of retention of dead fœtus *in utero* for three months.

[3] For signs of maturity of fœtus, especially its weight and measurements, consult Hecker, Monatschr. f. Geb., 1866, xxvii., 266; Casper-Liman, ii., p. 887; Toldt, Prag. Med. Woch., 189, 121; Schroeder's "Lehrb. d. Geburtsh.," 1888, pp. 58–61; Winckel's "Lehrb. d. Geb.," 1889, pp. 29–32; Vibert's "Précis de Méd. Lég.," 1893, p. 388.

[4] This table is abridged from Hofmann's "Lehrbuch der gerichtl. Medicin," 9th ed., p. 215. Compare Casper-Liman, ii., p. 884; also Barnes, Playfair, Parvin, etc.

Fourth month (sixteenth week): Fœtus 10–17 cm. long, weighs 43–120 grammes; sex differentiated; hair and nails begin to appear; average weight of placenta, 80 grammes; average length of cord, 19 cm.

Fifth month (twentieth week): Fœtus 18–27 cm. long, weighs 225–320 grammes; skin bright red and thin; meconium appears, colored with bile; average weight of placenta, 178 grammes; average length of cord, 31 cm.; point of insertion of cord, which was in the earlier months near the symphysis, begins to recede upward.

Sixth month (twenty-fourth week): Fœtus 28–34 cm. long, weighs 634 grammes (average); head not so relatively large as in earlier months; skin thicker and panniculus adiposus begins to develop; hair more abundant; vernix appears; testicles still in abdominal cavity; labia majora as yet slightly developed; labia minora and clitoris projecting between them; pupillary membrane still present; weight of placenta, 273 grammes; cord, 37 cm. long, and its insertion farther from symphysis.

Seventh month (twenty-eighth week): Fœtus 35–38 cm. long, weighs 1,218 grammes (average); hair of head is 5–6 mm. long; skin still red and thin; testicles begin to descend; cerebral convolutions begin to form; pupillary membrane often shows signs of disappearance toward the twenty-eighth week; a centre of ossification 2–5 mm. wide in os calcis—it can be made out in the second half of the sixth month; average weight of placenta, 374 grammes; average length of cord, 42 cm.

Eighth month (thirty-second week): Is the most important from a forensic point of view, because viability begins at end of thirtieth week (210th day). Fœtus 39–41.5 cm. long, weighs 1,500–2,500 grammes. Nails almost to end of fingers; ossification begins in last sacral vertebra; pupillary membrane gone; testicles in scrotum or inguinal canal; ossification centre in astragalus.

Ninth month (thirty-sixth week): Fœtus 44.2–46 cm. long and weighs 2,000–3,000 grammes; scrotum begins to wrinkle and vulva to close.

Signs of Maturity.—Fœtus 46–51 cm. long (18–20 inches), weighs 2,270–3,500 grammes (5–7 lbs.); males are generally longer and heavier than females; the head is large, being nearly one-fourth of the total length; skin pale, and nails reaching to the ends of the fingers; external auricle measures 2½–4 cm. long, 2–2½ cm. broad, and varies but little in children of different sizes; the point of ossification in the lower epiphysis of the femur appears about the thirty-sixth or thirty-seventh week, and at full term is 7–8 mm. in diameter; features perfect, hair abundant on head, body well developed.

Children vary greatly in size, weight, and development even when they have reached maturity; although the average weight is from six to seven pounds, yet a mature child may weigh as low as one pound or as high as twenty-eight and three-quarters pounds.[1] It would be impossible, therefore, in any given case to determine positively by weight or measurement whether a child is fully mature or not. The general development is a safer guide than weight and measurement, and it is better to affirm maturity only when the majority of the appearances found in mature children are present. It is better to err on the side of caution when giving a positive opinion regarding the maturity of new-born children.[2] (See also PREGNANCY, etc., this volume, pp. 535–539.)

---

[1] Parvin's "Obstetrics," 2d ed., p. 151.

[2] WEIGHTS OF FŒTUS IN GRAMMES.

	Hofmann.	Schroeder.	Winckel.	Spiegelberg.	Ahlfeld.
At end of first month (4th week)					
" second month (8th week)..	4				
" third month (12th week)....	5–20	5–20	up to 20	30	
" fourth month (16th week)..	up to 120	up to 120	43–117	55	
" fifth month (20th week)....	225–320	284 (av.)	139–350 (av.250–275)	273	
" sixth month (24th week)...	634 (av.)	634 (av.)	432–950 (700 av.)	676	
" seventh month (28th week).	1,218 (av.)	1,218 (av.)	820–1,155	1,170	1,635 (av.)
" eighth month (32d week)...	1,500–2,500	1,900 (av.)	1,335–1,615	1,571	2,107 (av.)
" ninth month (36th week)...	3,000 (av.)	2,500 (av.)	2,188–2,684	1,942	2,806 (av.)
" tenth month (40th week)...	3,000–3,500	3,100 (av.)	3,100–3,600	2,323	3,168 (av.)

Charpentier makes the weight of mature fœtus 3,000–3,500, but adds that it may be as low as 2,000—below 2,000 he would call it immature. Vibert makes weight at maturity 3,000–3,500. Tardieu gives a table of the weights of 4,104 infants born at term at the Maternity, Paris. The highest was 5,300 and the lowest 2,000 grammes; more than half weighed between 3,000 and 3,500 grammes. In commenting upon his statistics he says that we must admit that occasionally a child weighing 1,200 to 1,500 may be at term; but that if it weighs 3,000 it must be.

WAS THE ABORTION SPONTANEOUS OR INDUCED?

When it has been made out that abortion has actually taken place, the next point to determine is, whether it was due to natural causes or was artificially induced.

Natural Abortion.

Spontaneous abortion occurs more frequently than is generally supposed. Auvard states that probably there are as many abortions and premature confinements as labors at full term.[1] Hegar estimates that there is one abortion in the first month of pregnancy to every eight or ten full-term births.[2] Some authorities claim that very few fruitful married women pass through the child-bearing period without aborting.

During the first six weeks the ovum is very loosely attached to the uterus, and is easily separated and cast off. The uterus is then more sensitive to injury or irritation, and the woman, probably unaware of her condition, takes less care to avoid causes of excitement or irritation.

Abortion is also common from the twelfth to the sixteenth week, while arrangements for the placental nourishment of the fœtus are being perfected. Hofmann states that in his experience the majority of spontaneous abortions occur in the third and fourth months, that the sixth to the seventh month is the time when a macerated fœtus is usually expelled, and that the period of commencing viability is a critical time for the fœtus.

The actual cause of a spontaneous abortion may be traced to the ovum or the mother. Diseases of the embryo or the fœtal membranes may predispose to or determine abortion; in medico-legal cases it is important to remember such causes and exclude them if possible. Some women abort more easily than others, and more easily at one time than another. Some abort on the slightest provocation, while others may be subjected to great violence without disturbing the course of gestation. In one case a pregnant woman fell from a two-story window and broke both legs, but did not abort. On the other hand, it often happens that a misstep or sudden jar, a long walk, a ride in a carriage, or the use of the sewing-machine may suffice to produce hemorrhage and abortion. The ease or difficulty with which the ovum is detached or destroyed depends in great measure upon the healthiness or unhealthiness of the ovum and uterus; the health and environment of the pregnant woman are, therefore, important factors in such cases. Other things being equal, weakness, irritability, emotional excitement, and general ill-health facilitate abortion; it is, therefore, easy to understand why some women abort more readily than others, why the same woman aborts more readily in one pregnancy than another, and why abortion is so easy to induce in some, so difficult and dangerous in others. As a general rule a healthy ovum adheres with great tenacity to a healthy uterus; the ovum is not at the hazard of every gust of passion or emotion, and it is safe to conclude that when the attachments are easily broken up, there has been some unhealthy condition of the ovum or its environment.

---

[1] Auvard: "Traité d'Accouchements," p. 561.

[2] Schroeder: "Geburtshilfe," 10th ed., p. 460.

A legal point might arise as to whether a well-known habit of aborting might be alleged as a defence in a charge of criminal abortion. For example, some abortifacient drug (as ergot) may have been taken in moderate amount or in doses usually insufficient to produce abortion, nevertheless the woman aborts; would the smallness of the dose be a good defence, if it can be proved that the woman was in the habit of aborting easily? The medical witness should bear this in mind, and ascertain the woman's previous history as to the ease, habit, or frequency of abortion.

It has already been stated, that in abortions after the third month the fœtus usually comes away first, and then after a variable time the placenta and membranes are peeled off and expelled. Hours, days, weeks, or even months may elapse before the abortion is complete. Exceptionally the placenta may remain attached to the uterus and live or even grow (though this last has been recently disputed). In Jakob's case,[1] the woman aborted in the fourth month, but the placenta remained for seven months longer and finally came away as a hard mass without odor or signs of decomposition. Similar cases[2] have been reported by McClintock, Fairbank, Roth, Depaul, and others.

It may occasionally happen that the fœtus may be expelled

[1] Virchow's Jahrb., 1881, ii., p. 562.

[2] Hofmann, 9th ed., p. 219.

from the uterus some days after the mother's death, by the pressure of putrefactive gases. Ebertz reports the case of a primipara, æt. 20, in the ninth month of pregnancy, who suddenly developed suspicious symptoms (poisoning?), and died. On the third day afterward the fœtus in its membranes was expelled. The uterus, inverted, and its internal surface, with placenta attached, came through the vulva. The weather was very hot, and decomposition was rapid. The remarkable point is that there was no sign of labor during life, and no sign of abortion until three days after death. Theopold reports another remarkable case. The body of a woman who had died from hemorrhage during the later months of pregnancy was exhumed for examination on the fourteenth day after death. The weather was warm, and while the post-mortem was being made the head, enveloped in the membranes, suddenly emerged from the vulva. The fatal hemorrhage was due to premature separation of the placenta, and there were no signs of instrumental interference.[1] (See also POST-MORTEM BIRTH, this volume, pp. 613–623.)

Abortion is usually more dangerous to the mother than delivery at full term, chiefly from hemorrhage and septic infection. Severe hemorrhage may occur at the time of abortion; or if portions of placenta and membranes are retained, there may be recurrent attacks leading finally to fatal exhaustion. Sepsis occurs when pus-producing micro-organisms invade the retained matters and their poisonous products are absorbed. Such pus-producing bacteria must be introduced from without, generally by means of unclean hands, instruments, or dressings, rarely, perhaps, by impure air. The more the parturient canal is injured, the greater the risk of absorption and septic infection. It is evident, therefore, that such accidents are more liable to happen when abortion has been provoked than when it is due to natural causes. Yet great violence may be done, and even the uterine wall perforated, without causing any constitutional disturbance. (*Vide* Cases Nos. 10 and 12.)

The following table by Barnes[2] gives a very good summary of the causes of natural abortion:

Maternal Causes.—I. POISONS IN MOTHER'S BLOOD.

(1) Communicated. *Heterogenetic:* Fevers, malaria, syphilis.

---

[1] Vierteljahrssch. f. ger. Med., xlvii., 171.

[2] Barnes: "System of Obstet. Med. and Surgery," Amer. ed., p. 350.

Gases, as CO, CO_2.
Minerals: lead, copper, mercury.
Vegetable substances: ergot, savin.

(2) Products of morbid action. *Autogenetic:* as in jaundice, albuminuria, CO_2 from asphyxia, and in the moribund.

(3) Anæmia, over-suckling, obstinate vomiting.
Bright's disease, lithiasis, jaundice.

II. DISEASES DISTURBING THE CIRCULATION DYNAMICALLY.

Some liver diseases, obstructing portal system.
Heart diseases, excess of vascular tension.
Lung diseases, thoracic and abdominal tumors.

III. CAUSES ACTING THROUGH THE NERVOUS SYSTEM.

Some nervous diseases.
Shock, physical and psychical.
Diversion or exhaustion of nerve force, as from vomiting.
Reflex action.
Convulsion, apoplexy (these last two act partly through asphyxia, producing CO_2 in the blood).

IV. LOCAL OR PELVIC DISEASE.

Of uterus, as inflammation, hypertrophy, tumors, diseases of decidua.
Mechanical anomalies, as flexions and versions of uterus, fissures of cervix, pressure of tumors on uterus, or adhesions of uterus preventing its growth.

V. ADOLESCENT AND CLIMACTERIC ABORTION.

Uterus immature (infantile) or
Uterus in atrophic involution (senile).

VI. ARTIFICIALLY CAUSED BY VIOLENCE.

Blows, squeezing, puncture of uterus, injury to ovum.
Epidemic Abortion.
Sympathetic Abortion.

Fœtal Causes.—I. DISEASES OF OVUM.

Primary or secondary upon diseases of maternal structures or blood.

II. DISEASES OF EMBRYO, GENERALLY CAUSING ITS PREMATURE DEATH.

Faults of development.
Diseases of nervous system.

Diseases of kidney.
Diseases of liver.
Diseases, general, as syphilis.
Mechanical, as torsion of cord, or anything causing death of embryo.

If we can exclude natural causes, we are justified in concluding that abortion was induced.

WAS THE INDUCTION OF ABORTION JUSTIFIABLE?

A full review of the conditions which justify the induction of abortion or premature labor may be found in any of the larger text-books on obstetrics.[1] In general terms it may be said that the induction of abortion is justifiable—

(1) Whenever there is such mechanical obstruction that the birth of a viable child is impossible.

(2) Whenever the mother is suffering from such grave disease that her life is in imminent peril and can be saved only by the arrest of gestation.

The induction of premature labor is indicated when, from disease or pelvic deformity, the further continuance of pregnancy, or labor at full term, would expose mother or child to serious risks which might be diminished or avoided by the artificial arrest of gestation.

While the law does not formally recognize the right of a physician to provoke labor, yet the judges have always held that a physician is morally justified in interfering to save the life of mother or child which would be jeopardized or lost if nature were allowed to take its course; just as surgical operations are held to be justifiable, although no exception is made in their favor in the statute on wounding. A physician is as much justified in inducing abortion in suitable cases, as in amputating a limb or removing a cancerous uterus or breast, or doing an ovariotomy. Physicians should not undertake to arrest gestation, especially when the child is not viable and must perish as the result of the operation, without careful and serious consideration, preferably after consultation with a *confrère*, and always with the consent of the woman herself and the relatives duly attested.

---

[1] See Hirst's "System of Obstetrics," ii., pp. 195–200. Edgar's "Practice of Obstetrics," 2d ed., p. 956.

CRIMINAL ABORTION.

If it can be shown that abortion was not due to natural causes but was caused by interference, and if such interference was not undertaken by a competent medical practitioner for sufficient cause, the case is narrowed down to one of criminal abortion. The English law[1] reads as follows:

> "58. Every woman, being with child, who, with intent to procure her own miscarriage, shall unlawfully administer to herself any poison, or other noxious thing, or shall unlawfully use any instrument, or other means whatsoever, with like intent, and whosoever, with intent to procure the miscarriage of any woman, whether she be or be not with child, shall unlawfully administer, etc., shall be guilty of felony.
>
> "59. Whosoever shall unlawfully supply or procure any poison, or other noxious thing, or any instrument or thing whatsoever, knowing that the same is intended to be unlawfully used or employed with intent to procure the miscarriage of any woman, whether she be or be not with child, shall be guilty of a misdemeanor, and, being convicted thereof, shall be liable, at the discretion of the court, to be kept in penal servitude for the term of three years, or to be imprisoned for any term not exceeding two years."

The French, German, and Austrian laws are similar.

It is obvious, therefore, that if a woman tries to commit abortion on herself, or if another person tries to do so, or aids her in doing so, that woman or that person has committed a criminal offence, no matter whether the woman is really pregnant or not, whether the child is living or not, whether it is viable or not, whether it is deformed or a monster, whether the measures used (medicinal, mechanical, or instrumental) are effectual or not, or whether temporary or permanent injury has been done to the woman by the means used for that purpose. Nor does the consent or solicitation of the woman extenuate the criminality of the procurer. But from the very nature of the case, the woman must be almost invariably accessory to the abortion produced upon herself,[2] and the evidence of an accomplice if unsupported and uncorroborated is regarded with distrust. The late Fitz-James Stephen says: "When the only proof against a person charged with a criminal offence, is the evidence of an accomplice, uncorroborated in any material particular, it is the duty of the judge to warn the jury that it is unsafe to convict anybody on such evidence, although they have a legal right to do so." This is a great practical difficulty in securing the conviction of abortionists. The ignorance and unskilfulness of such persons increase the risks to which their victims are exposed. Most drugs used as abortifacients are violent irritants, and produce their effect mainly by causing intense irritation of the pelvic viscera; they are given in large doses, the effect of which is not unfrequently poisoning or grave abdominal or pelvic inflammation. If the woman's life is not sacrificed, her health is often shattered and irreparable damage done. When instruments are used to produce abortion, the ignorance or unskilfulness of the operator or the neglect of the necessary antiseptic precautions exposes the woman to serious risks from hemorrhage, inflammation, or septic absorption. If death results, the English law holds the operator guilty of murder, even though the operation was done at the request or with the consent of the woman, and without any intention of doing her permanent or serious bodily harm. The crime might be reduced to manslaughter provided the drug or instrument was not dangerous and was not used to destroy life, although employed for an unlawful purpose.[1]

---

[1] 24 and 25 Vict., cap. 100, sects. 58–59.

[2] If the woman is chloroformed or under the influence of liquor, or in any way rendered unconscious of what is being done, she cannot be an accessory, provided always she was unaware previously of what was to be attempted.

Clark Bell[2] says that according to the law in the United States, any person who does any act calculated to prevent a child being born alive, is guilty of abortion; that if death ensues in consequence of the means employed for this purpose the offence is murder at common law, though in some States it has been declared to be manslaughter; that the intention constitutes the crime, not the means employed.

Some confusion has arisen from the different interpretations given to the term "*noxious thing*" in the statute. What constitutes a noxious thing? Does the noxiousness consist in the thing itself, in the dose in which it was given, or in the circumstances of its administration? A single dose may not be noxious, but several doses given within a short time may be. One preparation of a drug may be comparatively harmless, another may be noxious. A drug administered to a non-pregnant woman may not be noxious, but may become so when given to a pregnant woman. The drug may or may not be injurious in itself; but if the dose given in a certain case was injurious under the particular circumstances, it was noxious in that case.

---

[1] R. v. Stadtmühler (Liverpool winter assizes, 1858); quoted by Tidy.

[2] Taylor's "Med. Jurisp.," 11th Am. ed., p. 526; Clark Bell, the American editor, refers to a number of American decisions illustrating various interpretations of the law as laid down in different States of the Union.

It was held in England[1] (R. *v.* Cramp) "that in such case it was a question for the jury to say whether the substance, administered as it was, and under the circumstances in which it was administered, was a noxious thing. Therefore neither principle nor authority precludes us from holding what is certainly good sense—that if a person administer, with intent to produce miscarriage, something which as administered is noxious, he administers a noxious thing." The statute makes it penal to administer any poison or other noxious thing, or to unlawfully use any instrument *or other means whatsoever* to produce abortion. It does not, therefore, seem necessary to prove the noxiousness of the drug employed, any *other means whatsoever* employed for the same purpose would be equally criminal. Such an interpretation is more in accord with the dictates of common sense as well as with the obvious intention of the law, and would greatly simplify medical evidence in cases of criminal abortion.

If a woman attempt to produce abortion upon herself without the assistance of others, the law makes the existence of pregnancy material to the charge[2] (Tidy).

MEASURES USED TO PRODUCE ABORTION.

The practice of abortion is common among savage and semi-civilized nations as well as among the most civilized. The ruder the nation, the rougher and more primitive are the means employed. Among the lower classes, we find many household remedies (folk-medicines, so to speak) which were used as abortifacients by the physicians of earlier days, and many of the manipulations and operations now in use have been practised since ancient times. In the ruder civilizations the materia medica is very simple, being chiefly confined to the plants familiar to them; hence the abortifacients used by them consist chiefly of decoctions or infusions of various indigenous roots and herbs. As Great Britain and America have been for years havens of refuge for the poor and oppressed of all nations, we find among the lower classes of our population many of the popular notions and superstitions of other countries engrafted upon our own. Hence we must be prepared to find in use not only those things which modern medicine would indicate as likely to have abortifacient action, but also a number of crude preparations and methods imported from other lands. The means adopted for procuring abortion may be divided into three classes:

---

[1] Med. Times and Gazette, March 6th, 1880; Dec. 25th, 1880, quoted by Tidy.

[2] Report of the New York Medico-Legal Society on criminal abortion (New York Medical Jour., xv., p. 77).

1. Drugs and other matters given internally.
2. General measures, which do not excite suspicion and are usually hard to detect and prove.
3. Local measures, in the form of direct interference with the ovum, uterus, and parturient canal.

I. **Internal Remedies** are by far the most frequent means used among the common people, and are generally administered in the form of decoctions or infusions of various roots and leaves, which have strong aromatic properties. As a rule, their abortive action is slight or none at all, although some do seem to have more or less effect upon the uterine muscle. The popular belief in their efficacy seems to come from a sort of *post hoc, propter hoc* reasoning. A pregnant woman, or one who believes herself to be so, takes a certain potion to bring on her courses; in due time she aborts, or her courses reappear, and thenceforth she is a firm believer in the efficacy of that potion, and hastens to tell the good news to her friends. From the earliest times certain drugs have been supposed to have abortifacient power, and their action has been attributed to a specific effect upon the uterus. In the great majority of cases, however, they act indirectly by causing profound excitement of the neighboring viscera and disturbing the functions of kidney, bladder, or rectum. Thus diuretics, purgatives, emetics, and various toxic drugs in large and irritating doses are employed as abortifacients quite as commonly as the so-called ecbolics. The success of such drugs depends in great measure upon the health and individual peculiarities of the woman herself. If she aborts readily, almost anything which produces great constitutional disturbance or pelvic irritation will succeed. If the attachments between the uterus and ovum are strong, the drug may require to be pushed to dangerous or even fatal doses, and even then death may occur without abortion having taken place. This accounts for the great diversity of opinion respecting the abortifacient value of different drugs, and the great number of them which are used for that purpose. It must be borne in mind, also, that an abortifacient may not only act directly or indirectly by exciting the uterus to contract and expel its contents, but that it may produce the same result in another indirect way by destroying the fœtus or interfering with its nutrition. Any drug, therefore, which makes the mother very sick, or which is carried over from the maternal to the fœtal circulation, may injure or destroy the fœtus, and sooner or later abortion may result. The younger and the smaller the fœtus, the more easily and the more certainly is it destroyed in this manner, and the smaller is the dose required. It is obvious, therefore, that powerful drugs are more likely to act as abortifacients in the earlier weeks of gestation than at a later date. Notwithstanding some negative observations, Lewin maintains that all poisons may pass over from the mother to the fœtus, either through the liquor amnii or through the epithelium of the chorionic villi.

DIURETICS have only feeble powers and generally fail. PURGATIVES which act upon the lower bowel may indirectly excite the uterus to action; the favorites are aloes, croton oil, jalap, gamboge, and elaterium. EMETICS, particularly of the depressant type, are apt to succeed in the later months. Tartaric emetic is the commonest and most effectual. ECBOLICS are supposed to have a direct effect upon the uterus itself, exciting it to vigorous contraction; the only one which is worthy of the name is ergot. EMMENAGOGUES, used to promote or excite the menstrual discharge, have little power as abortifacients unless taken in large and frequently repeated doses, when they act as drastics or stimulating diuretics, and thus indirectly excite the uterus to contract and expel its contents. TOXIC AGENTS, animal, mineral, or vegetable, may produce abortion in those who are predisposed, on account of the general constitutional disturbance they set up; the abortion is only one of the symptoms of the poisoning. They may act by destroying the fœtus or by indirectly exciting the uterus to contract.

Gastro-intestinal inflammation is usually more extensive and severe after criminal abortion than after natural miscarriage, and congestion of the kidney is generally found if abortifacient drugs have been used.

A few of the drugs most commonly used as abortifacients will now be considered in detail.

METALS AND THEIR SALTS.—*Iron.*—The sulphate and perchloride are the only salts which may produce ill effects by causing irritation. The dose must be very large to do any harm. Iron is given freely to pregnant as well as non-pregnant women for the cure of anæmia, without ill effect. While many cases have been recorded where iron has failed when given as an abortifacient, none has been reported where it has succeeded.

Mercury in the metallic form is useless as an abortive. Mercury in the form of calomel, corrosive sublimate, the iodides, administered by the mouth, inunction, vapor, or hypodermic injection, may be used as freely by the pregnant as the non-pregnant in medicinal doses. When pushed so as to produce severe salivation, it might cause abortion in those predisposed.

Arsenic is not an abortifacient. Taylor records a case where a woman in the fifth month of pregnancy took a large dose of arsenic to produce abortion; she vomited and purged severely, and died in seven hours, but did not abort. A girl of seventeen swallowed a package of insect poison, had severe symptoms of poisoning, but finally recovered and went on to full term.

Potassium.—The iodide in medicinal doses has no ill effect. The nitrate is reported in one case to have caused abortion. The chlorate has been used as an abortifacient. It has no specific action, but may succeed indirectly by reason of the vomiting and diarrhœa which it produces. The sulphate has been used in France.

Sodium.—The biborate (borax) ls commonly credited with abortifacient properties; there is no evidence to support this opinion.

Phosphorus.—Used extensively on the Continent, especially in Sweden. The heads of lucifer matches are soaked in water or scraped off. A large number of the cases end fatally. (*Vide* Case 5.)

Lead.—White-lead has been occasionally used. Freyer[1] reports a case in which 45 grammes of white-lead had been administered for the purpose of criminal abortion with fatal results. The same person had succeeded previously in producing abortion with white-lead in a woman four months pregnant. Pope[2] reported two fatal cases recently of self-administration of diachylon plaster as an abortive. Both complained of abdominal pain and tenderness and lost or weakened reflexes; there was a blue line on the gums. In both a spasm was observed shortly before death; one died from coma, the other from paralysis of the diaphragm. In one the post-mortem showed no trace of lead, but incineration of one kidney demonstrated its presence. In the other, the skin and conjunctivæ were yellowish, and the intestine was contracted and contained a yellow sticky fluid. (*Vide* Case 14.)

Carbonic Acid and Carbonic-Oxide Gas.—Several cases of abortion have been reported on the Continent and in America where the method of procedure was to attach one end of a rubber tube to a gas jet and to introduce the other end into the vagina. In one case, abortion took place on the third day. Fatal consequences may result from the entrance of gas into the uterine veins.

VEGETABLE PREPARATIONS.—*Savin* (Juniperus sabina), an irritant poison, whose active principle is an ethereal oil, with terebinthinate odor. A decoction or infusion of the leaves is a popular abortifacient potion; the oil or tincture is occasionally given. It has a powerful effect upon the genito-urinary system, and causes hæmaturia in animals. The odor is easily detected in the urine. Though dangerous to life when administered in large or frequently repeated doses, its abortifacient action seems to be uncertain. Abortion accompanied with violent flooding usually precedes death. Post mortem, there are evidences of gastro-intestinal inflammation, and the peculiar odor of the oil is generally found in the blood and body cavities.

---

[1] Zeitsch. f. medic. Beamte, 1888, 231. It must be borne in mind in this connection that chronic lead poisoning is a very common cause of abortion. Balland reports that among 30 women suffering in this way (typesetters, painters, jewelry-workers, flower-makers), out of 82 pregnancies only 24 ended normally, the remaining 58 being either abortions or premature labors (Thèse de Paris, 1896, No. 586).

[2] Brit. Med. Journal, July 1st, 1893, p. 9.

The contents of the stomach will be green, like pea-soup, if the poison has been taken as powder or decoction.

Rue (Ruta graveolens) is used in the form of a decoction of the plant and seeds. Its action is similar to that of savin but is less decided. Tardieu mentions three cases in which it produced abortion in fourth, fifth, and sixth month respectively, the woman recovering. Wood[1] says that he is not aware of any case where death followed the use of rue as an abortifacient, and the only fatal case recorded was that of a man weakened by dysentery.[2] Rue acts most powerfully when fresh.

Pennyroyal (Mentha pulegium). Used popularly in the form of infusion, as an emmenagogue and ecbolic, but has no more effect on the uterus than other varieties of mint.

Tansy (Tenacetum) is used largely throughout the United States as an abortifacient, in the form of decoction or oil. It is unsafe and is liable to produce violent abdominal pain, vomiting, epileptiform convulsions, and even death;[3] ʒ i. of the oil has proved fatal. It acts primarily on the spinal cord; small doses may produce numbness and pricking of the extremities or dilatation or immobility of the pupils, or convulsions in the highly nervous. Profuse salivation has been observed.

Gossypium, the root of the cotton-wood plant, is used in decoction by the negroes throughout the South, as an abortifacient. It is supposed to resemble ergot in its action.

Pilocarpin.—Gigeollet[4] has induced abortion by the hypodermic injection of this drug, and experiments upon animals have proved that uterine contractions may be caused either by hypodermic or intravenous injections.[5] It acts indirectly by lowering the patient's strength.[6] In large doses it is a very dangerous drug, especially for pregnant women. Its depressant action upon the heart may cause alarming symptoms. A fatal case has come under my own observation.

Saffron (Crocus sativus) in decoction is a popular abortive. It has not been proved to have any such action.

Yew (Taxus baccata) is said to have been used successfully in producing abortion.

---

[1] H. C. Wood's "Therapeutics," 8th ed., p. 806.

[2] Dr. G. F. Cooper, in Med. Examiner U. S., ix., 720.

[3] See United States Dispensatory for record of fatal cases, most of which have been in America.

[4] Hofmann, 9th ed., p. 225; *cf.* also Schauta's "Geburtshilfe," 1885, p. 48.

[5] Virchow's Jahrbuch, 1881, i., 455.

[6] London Medical Record, Jan., 1879.

Actea racemosa (black cohosh—squaw-root) has occasionally succeeded.

Hellebore (Helleborus niger) is a hydragogue cathartic and emmenagogue. It is active and largely used in the United States. Large doses give numerous painful fluid motions almost always accompanied by vomiting, tenesmus, heat through the hips, and bearing down. There is usually a pricking sensation in the tongue, fauces, and throat, with a feeling of constriction and epigastric pain. There is sometimes coldness of the extremities, with cold clammy perspiration. The pulse may fall to 50 or even to 30 beats per minute.

Tobacco is said to have abortifacient properties. Rocks investigated its effects among girls working in a tobacco factory. The evidence is not sufficient to warrant a positive conclusion.

Ergot of Rye (Secale cornutum) is a fungous growth on the grain of rye. It is commonly used in medicine as powder, tincture, or fluid extract, or in the form of a watery extract (ergotin). It is a very complex substance, and it is not yet settled what its active principle really is, the views of different chemists being very conflicting upon this point. It undoubtedly acts upon unstriped muscle and stimulates the uterus to tonic contraction. Hemmeter's observations prove that it may cause uterine action by stimulating the centres in the lumbar portion of the cord. It is still a matter of dispute whether its action upon the uterus is centric in origin or peripheral.[1] In small doses it aids and strengthens normal uterine contraction; in large doses it causes unyielding uterine spasm which drives all before it. Wood says that it has sometimes produced fatal abortion, but that he knows of only two cases of decided poisoning in non-pregnant women. When it does poison, the symptoms are mainly paralytic. It is less likely to cause death after a single large dose than if taken in smaller doses for some time. Tardieu reports the case of a woman, æt. 24, who aborted in the fourth month of pregnancy, after taking a dose of ergot in powder, and died of peritonitis in twenty-four hours; fragments of ergot were found in the lower bowel. In doses of 15 grains, it has produced nausea, vomiting, epigastric uneasiness, a sensation of fulness in the stomach developing afterward into pain. In large doses (ʒ ij.) it produced, in addition to these symptoms, dryness of throat, dizziness, dilatation of the pupils, abdominal pain, slowing of pulse, and finally delirium, coma, and death. Ergotin in doses of 3 to 8 grains has slowed the pulse to 18–12 beats per minute (Schroff). Besides its action upon the uterine muscle, ergot depresses the fœtal circulation and may thus produce abortion indirectly. It is still a matter of dispute whether ergot can originate uterine contraction, although it is admitted by all observers that it can intensify uterine action when once begun. It seems to be fairly well established that it may originate uterine contractions in a certain percentage of cases. Hofmann says that in 47 cases of premature labor in which ergot was employed, it succeeded without other measures in 32 cases. It has, therefore, true ecbolic properties, but is not certain in its action. This uncertainty has been attributed to the varying strength or freshness of the preparations employed, failure being due to inertness of the sample. Experience goes to prove that its abortive action is uncertain in small and safe doses, and that if labor is to be induced, it must be given in such large doses that there is danger of poisoning. Richter[1] records a fatal case: a woman, æt. 22, strong, in sixth or seventh month, had vomiting and great thirst for two days before being seen by a physician. He found her conscious, pale, very restless, with quick pulse, great thirst, pain in stomach and bowels, and retention of urine. Labor was going on and soon ended in the birth of a recently dead child. Half an hour afterward the mother died with profuse hemorrhage. Post-mortem appearances were great anæmia, slight injection of stomach, hemorrhage, erosions at the fundus and on the greater curvature, chocolate color of stomach-contents, and red streaks in the œsophagus. The poison could not be fully made out. When ergot has been given in powder and the case terminates fatally, fragments may usually be found in the intestine and recognized by their microscopic appearances, as well as by the fishy odor evolved when rubbed up with a solution of potash. When the tincture or fluid extract has been given, the recognition of the poison is difficult or impossible. And if ergotin has been administered hypodermically it is still more difficult to detect. The medical expert must not forget the possibility of the hypodermic method of administration in such cases.

---

[1] Wood's "Therapeutics," 8th ed., p. 818; a full statement of the different views regarding the action of ergot is given, together with a number of references. The article is a good *résumé* of the present state of knowledge regarding ergot and its action.

---

[1] Vierteljahrschr. f. ger. u. öff. Med., Berlin, 1861, xx., 177–233.

It will thus be seen that most so-called abortives are very uncertain in their action, that ergot is the only drug with true ecbolic power, and that when abortion follows the use of other drugs, the effect is attributable to the systemic disturbance caused by general poisoning rather than to any specific or primary effect upon the uterine muscle or lumbar centres. Thus any poison may become an abortifacient, the destruction of the fœtus or its expulsion from the uterus being one of the train of symptoms resulting from general systemic poisoning.

No doubt in many cases of poisoning the primary object has been to produce abortion. In Germany there are many cases of poisoning by lucifer matches among pregnant women; and it is now admitted that in most cases the object is to produce abortion, not to commit suicide. It is quite true that phosphorus may produce abortion; but it is a poison primarily, not an abortifacient.

When the court asks an opinion as to the abortive power of a drug, it is not needful to establish its specific action on the uterus or its certainty as an abortifacient; it is sufficient to show its special liability to set up constitutional disturbances which are apt to terminate in abortion. If such a drug is given to a pregnant woman, but in too small a dose to cause abortion, or if it fails because of the peculiar strength and resisting power of the woman, the charge still holds. But if a manifestly inert or unsuitable drug is employed, the charge would not hold, though there might be a point of law as to the intention.

If abortion actually occurs, and a certain drug is known to have been taken previous to the abortion, was the abortion caused by the drug? In order to answer this question, it must be determined whether the symptoms were such as would have been caused by the drug, or whether they might have been referable to other or natural causes; whether also sufficient time elapsed between the taking of the drug and the abortion to establish a relation of cause and effect. As already remarked, these abortives act by producing severe constitutional disturbance, as the result of which abortion occurs; it is obvious, therefore, that it would be wrong to attribute abortion in any given case to the action of such a drug, unless there had been severe constitutional disturbance before the abortion took place.

Most abortives are gastro-intestinal irritants, or narcotics; we would, therefore, expect to find vomiting or narcosis occurring shortly after the administration of the drug, followed by more and more marked symptoms of poisoning as time goes on; finally abortion occurs when the symptoms of poisoning are at their acme. It is important in such cases to save the vomited matters, if possible, for subsequent chemical and microscopical examination. Sometimes valuable information may be obtained from the chemical examination of the fœtal blood and tissues.

Dr. Ely Van de Warker[1] read an important paper before the New York Medico-Legal Society on the criminal use of proprietary or advertised nostrums. This paper deals with an important phase of criminal abortion, and will repay careful perusal. He states that these fœticidal preparations are dispensed in the form of pills or fluids. The oils of savin, tansy, and rue are the most active liquids. The main ingredients in the pills are aloes, hellebore, powdered savin, ergot, iron, and solid extracts of tansy and rue. These proprietary medicines generally have no directly poisonous action, but their effects on the health are very bad. A criminal use implies such persistence that functional derangement is sure to follow. The writer experimented upon himself with eleven varieties of these nostrums and details the symptoms which were produced, pointing out those which would lead one to suspect that an irritant preparation was being taken for criminal purposes. He draws attention also to an ingenious and indirect method of accomplishing the desired result. An inert pill is supplied, but among the printed instructions is the direction to drink tansy tea night and morning. This is a dangerous direction, and the intention is evident.

II. General Measures which do not excite suspicion, and are usually hard to detect and prove.

The object may be accomplished *directly* by exciting the uterus to contract, or *indirectly* by partially loosening the ovum from its attachments and injuring the membranes.

Whatever produces great or sudden congestion of the pelvic viscera or hemorrhage between the uterus and membranes is apt to cause abortion. From ancient times such measures have been in common use among the peasantry, and have been employed by women secretly or with the aid of accomplices. The following may be enumerated: Violent exercise, carrying or lifting heavy weights, long walks, running up and down stairs, jumping from a height, riding on horseback, driving over rough roads, general or local bloodletting, sinapisms to the thighs and abdomen, snuff-taking to provoke sneezing, tight lacing, leeching the perineum, vulva or inner surface of the thighs, alternate hot and cold baths, violence applied to the abdomen in the form of kicks, blows, kneading, compression with bands or ropes, beating with fists or sticks, and even standing, kneeling, or walking upon it.[1]

But such measures, violent though they be, do not always succeed in producing abortion. Brillaud-Lanjardière[2] relates the case of a peasant who took a pregnant woman on horseback, started off at full gallop and threw her violently to the ground; this was repeated twice, yet the woman did not abort. Hofmann tells of a peasant girl who let a heavy barn-door fall upon her abdomen without causing abortion. Another peasant, after trying various internal remedies without avail, struck his mistress on the abdomen with the flat of a sword; she fainted, but went on to full term. Hofmann mentions a case where a man, after failing with other means, sought to accomplish his purpose by frequent and forcible coitus, which he not only practised himself three or four times daily, but brought a friend who performed a similar service for him. Systematic massage of the uterus through the abdominal walls is less violent and more likely to produce the desired result; the painless contractions of the uterus are intensified thereby till true labor pains set in, and the fœtus is expelled. When abortion does result from the use of such measures, signs of external violence may be found which may throw light upon the case; but generally it will be difficult or impossible to establish a clear connection between the violence and the abortion, and determine whether the violence was accidental or criminal.

III. Local measures, in the form of direct interference with the ovum, uterus, or parturient canal.

Irritating applications are sometimes made to the vulva or vagina; pastes or tampons saturated with irritating balsams or juices have been introduced into the vagina[1] or applied to the os uteri; hot vaginal douches are in common use. The os and cervix uteri have been dilated with tents and pledgets of various kinds or instrumental dilators. Fluids have been injected into the uterine cavity, for the purpose of separating the membranes from the uterine wall;[2] and sharp-pointed instruments have been passed into the uterus to rupture the membranes or peel them from their attachments. Sharpened twigs, roots, branches, and sticks, pieces of wire, hair-pins, knitting or crochet needles, wooden skewers, quills, toothpicks, umbrella ribs, pieces of whalebone, uterine probes and sounds, scissors, etc., have been used for this purpose.[3] In Constantinople the women use the ribs of dried tobacco-leaves. Women often attempt to pass such instruments into the uterus themselves, and occasionally succeed, but are very apt to injure themselves seriously. When the membranes are ruptured and the liquor amnii flows away, abortion generally follows sooner or later. It is not so much the passing of an instrument into the uterus and the interruption of gestation which endanger the woman's life, as it is the hurry, inexperience, and ignorance of the operator or the filthiness of his hands or instruments. In competent hands and with a proper technique, the most serious operations may be undertaken upon the pregnant as well as upon the non-pregnant uterus, with comparatively little risk to the patient. The induction of abortion is not a serious operation and need not entail any special risks to the patient. But there is a great difference in the ease with which abortion is induced in different women, and in the time which is required with the same measures.[4] It is unsafe, therefore, to apply general rules to specific cases.

---

[1] Blood-letting or leeching is supposed to act by suddenly decreasing the mass of the blood and so interfering with the placental circulation and nourishment of the child. It seldom succeeds. Moreceau reports two cases where abortion did not occur, although one woman was bled forty-eight times and the other ninety times during the course of her pregnancy. Yet the proof of recent or excessive bleeding or leeching without good cause would be highly suggestive of criminal intent. *Cf.* Gallard, "De l'Avortement," p. 23.

[2] Brillaud-Lanjardière: "De l'Avortement Provoqué," Paris, 1862.

After the liquor amnii has drained away, abortion may occur in twenty-four hours, or perhaps not for days or even weeks. In Casper-Liman, a case is reported where a three-months fœtus did not come away till seven weeks after the repeated introduction of a sound into the uterus. Nothing definite can be said as to the time which massage of the uterus or violence to the abdomen may require to produce abortion. If massage sets up strong uterine action, abortion will soon follow; but if violence destroys the life of the fœtus without arousing uterine contractions, days or weeks may elapse before the fœtus is expelled. The degree of maceration of the fœtus may be some guide in estimating the time which has elapsed between the death of the fœtus and its expulsion.

---

[1] Garlic, pepper, and arsenic have been so applied,—Vierteljährl. Bericht f. ger. Med., xxv., 110; also N. F., i., 321.

[2] Maschka's "Gutachten," ii., 324. Hot or cold water, soapsuds, various infusions, antiseptic solutions, etc., have been employed for this purpose. Seydel reports a case in which acetic acid was used (Zeitschr. f. Medicinalb., 1895, p. 603); *cf.* also Friedreich's Blätter, 1892, p. 1.

[3] The old method of inducing abortion by boring the finger into the os seems to have been revived in Berlin in recent years (*vide* Virchow's Jahresbericht, 1895, i., 433). Consult also Vierteljahrsschrift f. ger. Med., N. F., i., 321.

[4] For a discussion of the time required to produce abortion by the methods generally in use, see Maschka's "Handb. der gerichtl. Med.," ii., 272–278. For a description of the methods see Hirst's "Amer. Syst. of Obstet.," ii., 203–208.

The question has often been raised whether a woman is able to pass a sound or other instrument into her uterus so as to rupture the membranes and provoke labor. It is quite possible for this to be done, if the woman has been taught how; but it is always difficult and apt to be dangerous.[1] In a woman who has borne children the uterus is generally lower down and the os nearer the vulva, than in a primipara; the os is more patent from the fissures or tears of a previous labor, it is more easily found and an instrument passed into the cavity of the uterus. It would be difficult, if not impossible, for a woman to pass a sound into her uterus if the os is high up and small, or in the virgin state.

It must not be forgotten that lacerations and wounds of the genitals may occur from indirect violence in an accidental manner. Ostermayer[2] recently reported an instructive case of laceration of the vagina without any criminal interference or operation or sexual violence. A woman, æt. 40, single, but had previously borne a child, was employed in a paper-mill. She fell down-stairs while carrying a heavy bundle of paper in her arms. She dropped her bundle and in falling struck her abdomen against the corner of a step. She immediately felt intense pain in the hypogastrium and then became insensible. In half an hour she revived, and, finding herself at the foot of the stairs, got up and went home. She then noticed blood coming from the vulva, which she took to be menstrual. Four days afterward she returned to her work at the mill. Three weeks after the accident she went to a hospital, where it was discovered that she had an oblique rent in the posterior vaginal fornix, two inches in length, looking like a clean incised wound with edges incurved toward the left. It was closed with catgut sutures and soon got well. Ostermayer attributes the wound to the sudden and forcible pressure of the abdominal and pelvic organs upon the vagina, when the abdomen struck the step. He quotes Henry's case where the bladder and anterior vaginal walls were lacerated when a woman was thrown violently out of a cart, striking her abdomen against the cart. Accidental lacerations of the vagina during sexual intercourse are common enough; sometimes they may be very extensive and may cause dangerous or even fatal hemorrhage. The diagnosis should present no difficulty.

---

[1] For illustrative cases *vide* Wiener klin. Wochenschr., 1889, No. 3; Centralbl. f. Gyn., 1893, No. 44. Resnikow reports the case of a woman who had twice produced abortion upon herself by introducing a sound into her uterus. She demonstrated her method to the physicians. Laguerre: "Contribution à l'étude de l'avortement criminel," Thèse, Toulouse, 1892–93. Guilhen, from personal investigation, found two women who used to pass the nozzle of an irrigator into the uterus, while they were in a sitting or squatting position, and 14 out of 16 prostitutes whom he examined that were in the habit of passing a sound up into the uterus.

[2] Centralblatt f. Gyn., No. 31, 1892, p. 614.

Besides the damage which is liable to be done to the uterus and vagina by the use of a sharp-pointed instrument, the presenting part of the child is apt to be injured. It is well, therefore, to examine the fœtus (presenting part) for abrasions, punctures, or wounds. Tardieu found a punctured wound in the large fontanelle in one of his cases.

It is possible for a fœtus to be seriously mutilated or even cut up into pieces while still *in utero*. Dr. Wherry reports a remarkable case of this kind where an instrument was passed up into the uterus for the purpose of inducing abortion. Two days afterward the trunk and extremities of a three-months fœtus came away, followed in an hour or so by the head. There was no decomposition; the skin was rosy and firm. After a sharp attack of peritonitis the girl finally recovered. The conviction was secured on the medical evidence solely, the girl's own testimony being ruled out.[1]

If abortion from natural causes takes place during the first two or three months of pregnancy, the ovum usually comes away entire, if the membranes are healthy, unless they have been broken by the examining finger or an instrument. It is, therefore, of importance to determine in any case of suspected criminal abortion whether the membranes were ruptured or not. Gallard[1] insists that rupture during the first three months is highly significant of induced abortion.[2] After that period the membranes generally rupture, and the embryo comes away first, followed some time afterward by the placenta and membranes. No definite rule can be laid down which will be applicable to all cases, for very much depends upon the toughness of the membranes, the strength of the attachment to the uterus, the force of the uterine contractions, and the amount of resistance offered by the cervix.[3]

---

[1] Brit. Med. Journal, June 4th, 1881, p. 880.

Electricity has long been known to be capable of exciting uterine action. The faradic current was proposed by Herder (1803), and successfully employed by Hörninger (1844), and Jacoby. The galvanic current was adopted by Schrieber (1844). The use of electricity for the artificial induction of abortion in suitable cases never became general in the medical profession, and was entirely dropped for a time, but recently attention has again been directed to it. The mild faradic current is safer. The negative pole is applied to the cervix in the posterior vaginal cul-de-sac, while the positive pole is placed over the sacrum or lumbar vertebræ. Rosenstirn[4] reports a case where an electrical bath was given and abortion followed next day. Although electricity is not used very much by the profession to induce abortion, there can be little doubt that it is very frequently employed for criminal purposes, especially in the United States. (*Vide* Case 16.)

Hypnotism.[5]—It has been suggested that a woman might be hypnotized and made to destroy her child through suggestion. It is true that pregnant women are hypnotizable, but the clearest proof would be required before such a plea would be admitted as a valid defence. Moreover, it would only shift the responsibility from the mother to the person who suggested the destruction of the child. Auvard says that the forensic value of hypnotism is very slight.

---

[1] Gallard: "De l'Avortement," p. 114; also, *cf.* Annales de Gyn., Août, 1875, p. 95.

[2] Dr. De Beauvais presented to the Medico-Legal Society of Paris drawings of 300 abortive ova which Dr. Saint-Ange had collected since 1832. He concludes that the ovum is expelled entire in the majority of cases.—Gallard, p. 115.

[3] Gallard's opinion is not to be relied upon in all cases; it is quite possible for healthy membranes to rupture while the ovum is being forced by a powerful uterus through a rigid and resisting cervix. Besides, it is possible for the ovum to be injured after it comes away.

[4] Virchow's Jahresb., 1881, ii., 562.

[5] For full discussion of this subject see Gilles de la Tourrette: "l'Hypnotisme au Point de Vue Médico-Légal," Paris, 1887.

SEQUELÆ OF ABORTIONS.

After it has been proved that a criminal abortion has taken place, and that certain drugs or manipulations were employed for that purpose, the medical expert may yet be called upon to say whether the woman's health was injured by those measures, whether her life was endangered thereby, and, if death took place, whether the abortion was directly or indirectly the cause.

Subsequent ill-effects may be due either to the abortion itself, or to the means employed to produce it. The most important after-consequences of the abortion itself are hemorrhage, sepsis, and subinvolution with its attendant troubles.

Hemorrhage is usually severe, far more so in some cases than in others. It is due to the rupture of vascular connections which have been established between the uterus and ovum for the growth and development of the embryo. As soon as the uterus can empty itself and close the mouths of the bleeding vessels by firm contraction, hemorrhage ceases. It is evident, therefore, that the degree and persistence of the hemorrhage will depend upon the speed and thoroughness with which the ovum can be expelled. The hemorrhage will be comparatively small if the ovum is completely extruded within a few hours; it is apt to be abundant or alarming if days elapse, or if all or part of the placenta and membranes remain behind. The circumstances of each case, the strength of the patient, the period of pregnancy, and the amount of blood lost must be taken into account in giving an opinion.

Sepsis.—The views usually set forth in works on medical jurisprudence are not in accord with the teachings of modern surgery. While the occurrence of septicæmia after an abortion may excite suspicions as to the use of instruments or criminal interference of some kind, it affords no reliable evidence one way or the other. The induction of abortion is not more likely to produce septicæmia than any other operation of equal gravity. Artificial abortion performed with strict antiseptic precautions, and with the same care and attention to details as is usual in other surgical work, should be a comparatively harmless operation for the mother.

Sepsis is caused by pus-producing micro-organisms introduced from without, not by causes existent in the woman or inherent in the operation. Septicæmia undoubtedly occurs more frequently in criminal than in natural abortion or abortion artificially induced by the obstetric surgeon;[1] but the reason is that the ignorance, unskilfulness, or carelessness of the operator, the unsanitary condition of the surroundings, or the uncleanliness of the patient or her attendants favors the entrance of pathogenic germs. Natural abortion in a dirty patient with dirty surroundings would be far more apt to end in septicæmia than an artificial abortion with considerable violence and loss of blood if strict antiseptic precautions had been observed. The teachings of modern antiseptic surgery should be borne in mind when estimating the after-consequences of criminal abortion.[2] (*Vide* Cases 2, 3, 7, 8, 9, 10, 12, 13.)

Subinvolution, with its attendant flexions, versions, displacements, menorrhagia, leucorrhœa, etc., is very apt to follow abortion. Much depends upon the thoroughness with which the uterus was emptied, the length of time the patient remained in bed, and abstained from active work or exercise, the amount of blood lost, and the nourishment and care she had afterward. In criminal abortion, secrecy is the great object; the patient is therefore more likely to get out of bed too soon and resume her ordinary employment, and less likely to get the rest, care, and nourishment necessary for a good recovery.

Ill effects from abortive measures are proportionately common. As already shown, most abortifacient drugs are irritant poisons and produce abortion by exciting grave constitutional disturbance. If given in large doses the symptoms are acute, if in smaller doses continued for a longer time, they are subacute or less marked. If the woman aborts and recovers, the convalescence is protracted and subacute, or chronic gastro-intestinal symptoms are apt to continue for a long time. Hemorrhoids, general debility, nervous prostration, irritability of the bladder, indigestion, vomiting, diarrhœa, constipation, symptoms of pelvic congestion, and menstrual disturbance may be mentioned as common after-effects of abortive drugs.

---

[1] Sepsis is highly suspicious but not conclusive of interference. It has been estimated that a fatal result occurs in 79 per cent of cases of criminal abortion. Out of 96 cases of criminal abortion, 76 ended fatally, while of 26 cases of abortion carefully induced with antiseptic precautions, none died.

[2] It might become a question in cases of malpraxis whether proper care had been taken to provide against the risks of infection. Was the technique aseptic? Did the operator act according to the principles of modern antiseptic surgery? If not, would he not be open to a charge of criminal carelessness or negligence? In such a case it would be necessary to exclude other causes of death, and other means of conveying infection.

When vaginal douches have been used or fluid has been injected between the membranes and the uterine wall, there may be peritonitis or metritis, usually septic in origin; or sudden death from the entrance of air or fluid into the uterine sinuses, or acute peritonitis from the passage of air or fluid along the Fallopian tubes into the abdominal cavity. When instruments have been introduced by ignorant or unskilled persons to rupture the membranes and bring on labor, traumatisms are almost certain to exist. These are usually confined to the vulva, vagina, cervix, and lower part of the uterus; but where much force has been used they may be found even in the fundus. The size and appearance of the traumatism will depend upon the kind of instrument used, and the amount of force or roughness. Small sharp-pointed bodies like sounds, knitting-needles, etc., produce punctured wounds which may be hard to detect and may be easily overlooked. If the woman is alive, they may have closed completely before the examination is made, the appearances differing in no respect from those of natural abortion.[1] When scissors or large rough instruments have been used, or where much violence has been done, the traumatisms will be correspondingly greater and more easily recognized. They will have the appearances of cuts or tears with more or less bruising. The fœtus may or may not be injured, even if the uterine wounds extend as high as the fundus. Hofmann relates a case where the posterior bladder wall was perforated. Dr. Jackson reports the wounding of the internal iliac artery by an instrument used to bring on abortion. Maschka[2] reports five cases of fatal perforation of the uterus during an attempt to rupture the membranes. The history in all was much the same; they visited or were visited by a midwife, some instrument was passed into the uterus, then came hemorrhage, pain, vomiting, fainting, and abortion, followed by symptoms of acute septic peritonitis, and death in from two to five days. Post-mortem examination showed abundant purulent fluid in the abdomen, evidences of general and recent metritis and peritonitis, and a large flabby uterus with a wound somewhere in its walls (sometimes perforating, sometimes not), with irregular necrosed edges.

---

[1] If the woman dies before the vital processes have obliterated the marks of injury, conclusive evidence regarding their nature and extent may be obtained even though the body has been buried for some time. Draper reports that in a body exhumed within 2 months after death, 4 wounds were found on the posterior vaginal wall; 3 were superficial, but the fourth formed a canal leading up into the Douglas pouch, where was found an encapsuled focus of suppuration.

[2] Vierteljahrsschrift f. ger. Med., xli., 270; xlii., 32.

Sometimes the most frightful injuries are produced. A strong young woman, æt. 20, in the fourth month of pregnancy, had labor induced by a physician by means of a hard gum elastic catheter. Either the force used in introducing it or the uterine contractions caused the catheter to perforate the fundus and make its way up under the liver. During his frantic efforts to remove the placenta, he scraped through the cervical wall and removed portions of it for placental tissue. He then introduced an ovum forceps through the cervical wound, and dragged down a loop of intestine, mistaking it for the cord, and tore away a portion of the bowel.[1] In another case, a woman, æt. 28, IIpara, in her fourth month, was seized with severe pains while washing windows. The next night the fœtus came away, and the midwife removed the so-called afterbirth by pulling upon the cord. The post-mortem showed that the uterus had been partially inverted, probably by the traction on the cord, and that while trying to separate the placenta she had gouged out and removed the whole of the fundus.

The expert must not only determine the site, extent, and probable origin of the traumatisms, but must trace the septic or inflammatory processes to them, excluding other causes.

A case was tried in Paris in the spring of 1881, which attracted considerable attention at the time from the social standing of the accused, who was a retired army surgeon, nearly seventy years old, and Commander of the Legion of Honor. His victim was a girl of eighteen. Peritonitis set in shortly after the operation had been performed, and the girl was removed to a hospital, where she died. Professor Brouardel found lesions about the genital organs which indicated criminal interference; but in addition there was a cyst in the liver sufficient to cause death. The accused was acquitted because Professor Brouardel could not tell positively whether death was caused by the cyst in the liver or peritonitis following the operation for abortion. Moreover he suggested that possibly the cyst in the liver may have been produced by the criminal violence.[2]

---

[1] Amer. Journ. of Obstet., July, 1892, p. 69.

[2] Brit. Med. Journal, Oct. 30th, 1880, p. 722; Feb. 19th, 1881, p. 285.

Where traumatisms are found, the important question to determine is whether they occurred spontaneously or were produced artificially.[1] Perforating wounds of the uterus do not occur spontaneously; penetrating rupture of the uterus is very rare, generally occurring at or near full term, the uterine walls being weakened near the point of rupture by disease, cicatrices, or fibromata. Healthy uterine tissue does not tear spontaneously; and unhealthy conditions can be made out by careful microscopic examination of the tissue near the site of the tear. Is it thin or cicatrized, is a fibroid situated near by, or was the placenta attached thereabouts? The size, shape, and appearance should be noted. In the first six months, spontaneous rupture is still rarer, although it has occurred in the fourth, third, or even second month.[2] Rupture of the uterus may occur in the early months in the rudimentary horn of a double uterus.[3] Ruptures of the uterus apart from labor have been doubted, yet Hildebrandt has published one case.[4] Piltz[5] describes a rare case of spontaneous rupture of the fundus during labor. A rare case of spontaneous rupture of the uterus in the cicatrix of a previous rupture was reported recently with a diagram in the *Archiv für Gynäkologie.*[6] Remarkable cases

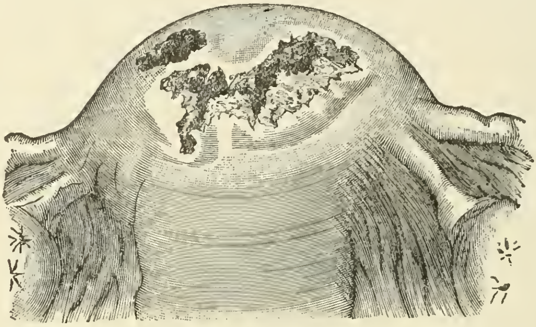


FIG. 23.—Multiple Perforation of the Fundus Uteri with Septic Softening of the Edges Causing Subsequent Enlargement of the Original Wounds. The woman was in the fifth month of pregnancy and passed a goosequill into her uterus to induce abortion (Hofmann).

---

[1] *Cf.* monograph by Dr. Marsais: "Des Blessures de la Matrice dans les Manœuvres Criminelles Abortives," Lyon, 1890. He has collected 68 cases, and enters fully into the ways by which a spontaneous perforation may be distinguished from an artificial wound.

[2] Monatsch. f. Geburts., xii., 408.

[3] Maschka, in Prag. Med. Wochenschr., 1882, No. 49.

[4] Virchow's Jahrsb., 1872, p. 669.

[5] Deutsch. med. Zeitung, 1889, p. 1221.

[6] Archiv f. Gyn., xliv., Heft 3, p. 396.

of recovery after rupture of the uterus have been recorded. A very extraordinary one was published by Rose[1] in the *Chicago Medical Journal and Examiner*, in which rupture of the uterus took place in four successive pregnancies (1869, 1872, 1874, 1876), in the same woman with a normal convalescence in all.

When determining the kind of instrument used in making a certain wound, it should be remembered that a slight wound or puncture may be greatly enlarged by uterine contraction or subsequent necrosis. Spencer Wells[2] states that during an ovariotomy, he accidentally punctured the pregnant uterus. The small wound suddenly enlarged into a great tear during and as the result of uterine contraction. Inflammation and necrosis may also extend the size or alter the shape of a

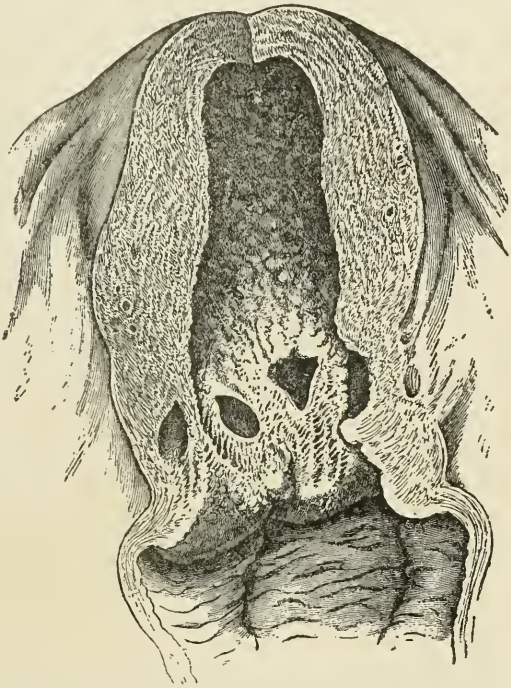


FIG. 24.—Abortion in the Third Month. Death in ten days from peritonitis. Wounds about the os internum, with loss of substance (Hofmann).

---

[1] Centralblatt f. Gyn., i., p. 316.

[2] Med. Times and Gazette, Sept. 30th, 1865.

wound.[1] When the wounds occur in the cervix, it may be claimed that they were the natural result of labor and not caused by violence. A careful study of the symptoms as well as an examination of the parts will usually give sufficient data upon which to base an opinion. Hofmann describes two cases illustrating the appearances in a fatal case of perforation of the cervix (Figs. 23 and 24).

Rupture of the uterus may also occur from forcible injections of fluids into its cavity.[2] The site of the rupture is important to consider in diagnosing spontaneous from traumatic rupture.[3] Spontaneous ruptures are usually in the cervix or lower uterine segment, are transverse or oblique, rarely longitudinal, have the appearance of a tear, and are usually accompanied by copious hemorrhage, sometimes proving rapidly fatal. Artificial ruptures may be anywhere, and are usually multiple, sometimes involving the intestine, bladder, rectum, or vagina, are generally longitudinal, there is necrosis or suppuration only in the vicinity of the wound, the mucous membrane being healthy elsewhere.[4] Other accidents may occur during the introduction of instruments into the uterus for the induction of abortion. Death may occur from shock.

Vibert[5] reports an interesting case in which shock occurred at the moment a rubber canula was introduced into the cervix, and the woman died in five minutes. The abortionist (a woman) was expert and experienced, having done over one hundred abortions in a year. Her method was to introduce a canula into the cervix and distend the lower uterine segment with injections of water. (Case No. 6.)

[1] Winter presented such a case to the Berlin Gyn. Soc. on Nov. 12th, 1886, and Richardière mentions another (Virchow's Jahrsb., 1888, i., 516). *Cf.* also Hofmann, 9th ed., pp. 249–252.

[2] Coutagne: "Des Ruptures Utérines pendant la Grossesse, et de leurs Rapports avec l'Avortement criminel," Paris, 1882.

[3] It may be impossible to determine from the post-mortem examination whether a rupture of the uterus was spontaneous or caused by violence or manipulation. The violent nature can be affirmed only if the rupture is situated above the contraction-ring, and in cases where there has obviously been instrumental perforation of uterus or vagina. In crossbirths, if the rupture can be made out to have been on the side where the breech lay, it was probably due to violence. Hemorrhage is the cause of death after rupture of the uterus, only when immediate. If death occurs after twelve to twenty hours, it was probably due to sepsis before symptoms of peritonitis had time to develop.

[4] Compare Lacassagne: "Des Ruptures de la Matrice consécutives à des Manœuvres abortives," Paris, 1889, pp. 5–12.

[5] Société de Médicine légale—Bulletin Méd., 1890, p. 639.

Tetanus has occurred after criminal abortion; Sattler[1] reports the case of a healthy woman, æt. 30, IIIpara, in her second month, who developed tetanic symptoms on the second day after the passage of an instrument for the induction of abortion, and died on the fourteenth day. There was a small perforating wound of the posterior vaginal wall (Fig. 25).

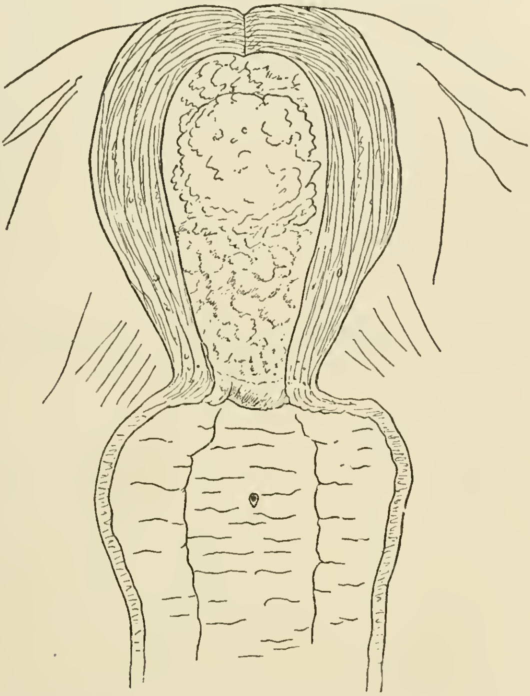


FIG. 25.—Perforating Wound in Posterior Vaginal Wall with Loss of Substance. The wound was oval, 3 mm. long, and 2 mm. broad, with discolored edges. The patient died of tetanus on the seventh day (Sattler).

While the uterus sometimes resents interference, it occasionally withstands much handling without being provoked to expel its contents. Fritsch[2] passed a sound on the 20th October for the purpose of inducing abortion. Considerable pain was felt when the point of the sound entered the os. A laminaria tent was then passed into the cervix and the vagina tamponed. When the tampon and tent were removed, there was hemorrhage, and it was supposed that the ovum had come away. The patient not being satisfied that the uterus had been emptied, Fritsch passed a sound into the uterine cavity fourteen days afterward, and moved it about in every direction; considerable blood came away, yet pregnancy continued. On the 14th January following, a bougie was introduced into the uterus and left there, and abortion finally resulted. Oldham[1] records a case where it was sought to induce abortion in the third month on account of vaginal contraction. A sound was passed into the uterine cavity without further result than a white discharge, and slight pain in the abdomen. After twenty-six days, the membranes were ruptured and abortion took place in seven days.

---

[1] Sattler: Inaugural-Dissertation: "Ein Fall von Tetanus nach kriminellem Abortus," Tübingen, 1890.

[2] Centralblatt f. Gynäkologie, iv., p. 197.

THE DUTIES OF MEDICAL EXPERTS IN CASES OF CRIMINAL ABORTION.

I. Examination of the Woman.

During Life.—The value of medical evidence depends upon the time which has elapsed between the abortion and the examination. The sooner an examination is made, the more likelihood will there be of obtaining positive evidence; the longer it is deferred, the greater likelihood will there be of fallacy and negative results. Much depends upon the period of gestation; the earlier it is, the less marked will be the signs diagnostic of abortion. Each case, therefore, must be decided upon its own merits, as no general rule can be laid down applicable to all. In some cases, abortion cannot be affirmed positively after twenty-four hours; in others it may be demonstrable after several weeks. When bits of placental tissue or fœtal membranes are found adhering to the uterine walls days or weeks after the expulsion of the embryo, the proof of abortion is positive; but a diagnosis based upon the examination of the woman before the formation of the placenta is very uncertain and liable to many fallacies. The phenomena of profuse menstruation, subinvolution after a previous abortion or confinement, enlargement and congestion of the uterus from fibroids, polypi, and other causes, may lead to error. Before declaring positively for abortion, the medical expert must exclude these and all other pathological conditions which might produce similar appearances. There need be no very great difficulty in doing this; a careful bimanual examination, the thorough exploration of the pelvic cavity and its contents (under ether if need be) should seldom leave much room for doubt. Method and thoroughness in the examination are essential for the formation of a trustworthy and positive opinion. (*Vide* Case No. 17.)

---

[1] Lond. Med. Gazette, 1894.

It would greatly facilitate the ends of justice if the courts would take expert advice and draw up a series of rules for the preparation of medical evidence and the making of post-mortem examinations in medico-legal cases. The general practitioner unaccustomed to medico-legal work is very apt to overlook matters of vital importance from the legal point of view; indeed a case often hinges upon slight circumstances which at the time of examination may have seemed unimportant. If a complete examination is not made at once, it may be too late afterward; every hour impairs, every day destroys significant evidence, which no amount of care, skill, or experience can subsequently restore or replace. It will, therefore, be readily understood that only a relative value can be placed upon the evidence obtained from the examination of the living woman.

The signs of abortion are usually stated to be general relaxation of the genital tract, patulousness of the os and cervix, with or without fissures, erosions, or tears, the presence of lochia, varying in color and character according to stage, from the reddish discharge of the first few days to the greenish, whitish, or yellowish discharges of later periods. The enlargement of the breasts with their characteristic color-changes, and the presence of colostrum, are valuable points. Traumatisms of the vulva, vagina, and cervix can only be made out satisfactorily by inspection, in a good light, with the aid of speculum and retractors. The size of the uterus is determined by bimanual examination. The constitutional symptoms will depend upon the period of pregnancy, the amount of violence, the expertness of the operator, and the use or neglect of antiseptic precautions. There may be no rise of temperature or pulse and no constitutional disturbance. The importance attached by older writers to the temperature, pulse, dryness of skin, sunken eyes, haggard countenance, etc., must be largely discounted nowadays when expertness in gynæcological operations is greater and more general, when the technique is improved, and obstetricians are accustomed to practise the rules of antiseptic surgery. The expert should not confine his attention to the breasts and genitals, but should also examine the body for marks of violence.

After Death.—If decomposition is not too far advanced, the examination post-mortem should be easier and give more definite results than one made during life. The whole pelvic viscera and genital tract should be carefully inspected, great care being taken to avoid jagged cutting when examining the uterus and vagina. The organs should be laid open with clean-cut incisions, lest post-mortem wounds be mistaken for or confounded with traumatisms connected with the abortion. These latter are usually in the form of punctures or lacerations, irregular in contour, accompanied by loss of substance, and generally multiple. If the woman has lived for some time, there will be efforts at repair, cicatrization, more or less complete granulation, and the presence of blood, lymph, or pus about the wounds. Spontaneous or natural wounds or tears are recognized chiefly by their site, extent, and appearance. Care should be taken to look for evidence of irritant poisoning by abortifacient drugs—the stomach, intestines, kidneys, bladder, and urine should be minutely examined. Are the viscera in a state of general anæmia from sudden and profound loss of blood? If the woman died during a menstrual period, it should be borne in mind that the uterus and pelvic viscera will probably be found in a state of congestion.

II. The Examination of the Ovum, Fœtus, Clots, etc.

If a fœtus has been expelled, the examination should determine its probable age, maturity, and viability, whether it was born alive, the cause of death, the presence of wounds or injuries, and whether these were inflicted during life. If any portion of the fœtal membranes are discovered (amnion, chorion, placenta) the proof will be positive; but a microscopic examination is necessary to remove all doubt. While the presence of fœtal structures absolutely proves abortion, their absence does not prove its non-occurrence. A careful inspection should be made of blood-clots, stains upon the bedding or clothing, and a microscopic examination made if necessary.

III. THE EXAMINATION OF DRUGS, OR INSTRUMENTS SUPPOSED TO HAVE BEEN USED TO PRODUCE THE CRIMINAL ABORTION.

Instruments should be examined carefully for stains of blood, hairs, and fragments of maternal or fœtal tissues. It is also important to compare them with any wounds which may exist on the body. With regard to drugs it is important to determine not only what they are but also how active they are. Liman[1] records a case where a decoction of savin had been taken as an abortifacient; the residue was sent to him for examination. He found it dried up and odorless when rubbed; he testified that the sample submitted to him was inert as an abortive, having lost its active principle entirely. Liman[2] reports another case where a physician was accused of having prescribed an abortifacient mixture for a widow. The questions submitted to the medical expert were, whether the mixture if taken as prescribed was such as would produce abortion, and whether by the use of it the patient's health was seriously endangered. The prescription was a strong infusion of senna and savin with saffron syrup and cream of tartar. After taking this mixture for three days the woman aborted. The prominent symptoms were profuse diarrhœa, sharp cutting abdominal pains, weakness in the thighs, and inability to work for several days. These were all attributed to the senna, which was given in large enough doses to cause severe intestinal irritation and sympathetically excite the uterus to contraction. The other ingredients were considered as inoperative in the case, and the opinion was given that the mixture as prescribed was likely to cause abortion and seriously injure the patient's health.

Tidy gives the following table, which may be useful for reference as suggesting the line of inquiry to be adopted in cases of suspected criminal abortion:

---

[1] Casper-Liman, i., 241. Many popular abortifacient drugs owe their power to an ethereal oil which soon evaporates, leaving the residue inert. Decoctions made from dried herbs are often inert on this account.

[2] *Ibid.*, i., 261.

I. *Examination of the mother, if living.*

- (1) Temperature.
- (2) As to the woman's predisposition to abort, and the period at which abortion has commonly occurred.
- (3) General state of health. (Note existence of leucorrhœa, excessive menstruation, syphilis, asthma, malignant disease, uterine diseases, etc.)
- (4) Whether the woman be well- or ill-formed. (Note pelvic malformations, effects of tight lacing, etc.)
- (5) Whether or not there be signs of recent delivery or of the expulsion of uterine contents.
- (6) Whether any cause can be assigned to account for the abortion (*e.g.*, violent coughing, blood-letting, straining at stool, violent exercise, undue excitement, septic poisoning, violence, administration of medicines, etc.).
- (7) All injuries of the genital organs. (Consider whether the injuries might be self-inflicted.)

II. *Examination of the body of the mother, if dead.*

Note

- (*a*) The necessity for care not to mistake the effects of menstruation for those produced by abortion.
- (*b*) To avoid injuring the parts by the knife or otherwise during the autopsy.
- (*c*) To consider the possibility of injuries being self-inflicted.

- (1) Note the existence of any marks of violence on the abdomen or other parts.
- (2) The condition of the genital organs, noting all inflammations, rents, tears, perforations, etc. (if the uterus be injured, if should be preserved).

Note also

- (*a*) The condition of the passage (relaxed or otherwise).
- (*b*) The condition of the os uteri (virginal, or gaping, etc.).

(*c*) Vaginal secretions, and if present, their character.
(*d*) The general appearance of the breasts, presence of milk, etc.

(3) Whether there be any signs of irritant poisoning in the stomach, or inflammation of the bladder, kidneys, rectum, etc. (The contents of the stomach to be preserved if necessary.)
(4) Whether the viscera generally indicate loss of blood during life.

III. *Examination of the product of conception.*

(1) Nature of the supposed product of conception.
(2) Consider whether there is evidence of a diseased condition of the membranes or placenta, *e.g.*, structural degeneration.
(3) If a fœtus be found, determine (*a*) whether it was born alive; (*b*) its probable age; and (*c*) the cause of its death.
(4) Determine whether, if there be wounds or other injuries, they were inflicted during life or after death.

IV. *Examination of all drugs, instruments, etc.*

If the woman is living and can be kept under observation for a short time, the progressive involution of the uterus and disappearance of the signs found during pregnancy will enable a positive diagnosis to be made. As involution proceeds the uterus should become smaller, the discharges less copious and bloody, the breasts more flaccid and free from milk, the dark pigment streak down the linea alba should fade, so should the dark color from the areola. No pathological condition at all resembles the process of involution.

In examining clots and other matters which may have passed from the genitals of the accused, it is always of prime importance to examine carefully for any signs of a product of conception. It is well to float all suspected matters in water, when the ovum or any portions of the chorionic villi which may be present will float free and can generally be recognized without difficulty. If any small fragments of tissue are found in the water which look suspicious or doubtful, a small portion should be clipped off with scissors and examined microscopically on a glass slide in either water or glycerin; if it is chorionic tissue, there will be easily seen under a low power the characteristic chorionic villi with club-shaped ends containing a vascular loop covered with flattened epithelium (see Figs. 26, 27, 28, 29). If these are not found, or if the villi happen to be imbedded in uter-

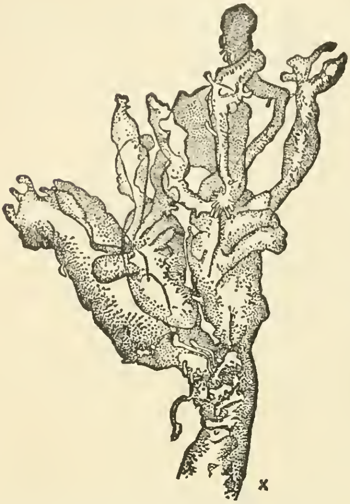


FIG. 26.—Isolated Terminal Branch of a Villus from the Chorion of an Embryo of

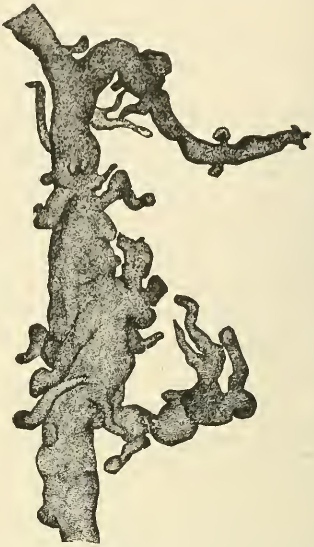


FIG. 27.—Villous Stem from a Placenta of the Fifth Month. × 9 diams.

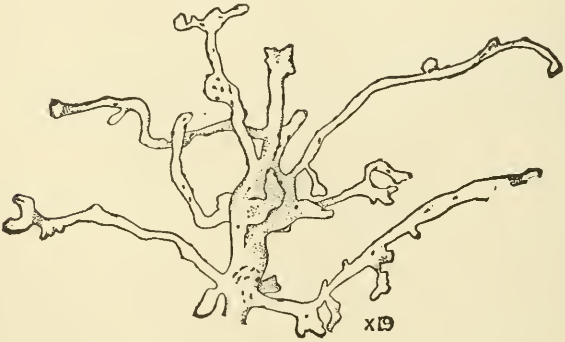


FIG. 28.—Terminal Villi of a Placenta at Full Term. The little spots represent the proliferation islands of the covering epithelium.

ine decidual tissue (as in the case of fragments removed from the internal surface of the uterus by curetting), it is better to imbed the portion to be examined in paraffin or celloidin, then cut sections and stain them and examine under the microscope. (*Vide* note 1, p. 360.)

ILLUSTRATIVE CASES—ABORTION.

1. *Fatal Case of Criminal Abortion—Conviction of the Abortionist. Trans. Massachusetts Med. Leg. Soc., i., p. 79. Boston*, 1888 (Gleason).—A woman in the sixth month of pregnancy and in perfect health went upstairs with Dr. Gilson carrying a basin of warm water; in twenty-five to thirty minutes he came down hurriedly for brandy; when the servants went up with him they found the woman lying on the floor dead. A tub containing a small quantity of bloody water was near by. One of the servants had lent the doctor a common rubber syringe which was found concealed in a bureau close to the bed, *still wet*. A strange nozzle was attached to this syringe, which fitted to a female catheter which dropped from the person of Dr. Gilson when he was committed for trial. The strange nozzle was not on the syringe when lent to the doctor and did not belong to it. A bottle of tincture of aloes and myrrh was found in the room, and a small quantity of cotton-root extract in the kitchen. The servants testified that the doctor had visited the deceased and that she had taken both the cotton-root and tincture. The post-mortem showed that force from without had dissected up the membranes and edge of the placenta. Water or any similar fluid forcibly infected into the uterus would produce similar appearances. There was no evidence of disease or any other cause of death than uterine interference. There had been very little blood lost, and death was due either to shock, embolism, or the entrance of air into the uterine veins. The syringe was leaky, and air no doubt entered the uterus along with the fluid.

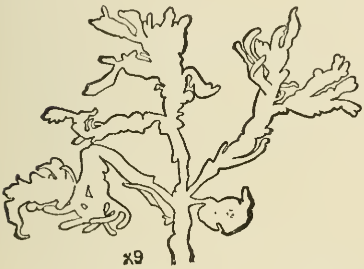


FIG. 29.—Aborting Villus from a Chorion of the Second Month.

2. *Fatal Case of Criminal Abortion—Septicæmia (unpublished)* (Cameron).—A multipara, æt. 42, had been under the care of a noted abortionist for gastro-enteritis. She had several large hemorrhages from the genitals, and had been vomiting for several days. When she came under observation she was delirious, deeply jaundiced, with a subnormal temperature and rapid thready pulse. An offensive discharge was coming from the vulva. She was douched out, and the

uterus thoroughly curetted, removing a quantity of decidua and some placental tissue. She died of septicæmia five days after having come under observation.

Post-Mortem.—The parotid glands on both sides were swollen, the neighboring tissues being œdematous. There were numerous points throughout the gland tissue from which a small quantity of thick curdy pus could be squeezed. The cervical glands were also slightly swollen. The mammary signs of pregnancy were present and there was milk in the breasts containing colostrum corpuscles. There was broncho-pneumonia of the right lung with embolism of the right pulmonary artery. In the abdomen there were signs of commencing general peritonitis. The uterus was enlarged; the placenta had been attached low down on the left side, and reached to one-quarter of an inch from the internal os. Just within the external os were two depressed furrows with considerable loss of substance, one on the right, the other on the left side of the canal. They were evidently of traumatic origin and recently made. Edges undermined, deeper above than below, no signs of granulation or cicatrization. Tubes normal. No traumatisms in vagina. The opinion was given that death was due to septicæmia following an abortion probably induced by the introduction of a uterine sound or other such instrument. There was no evidence of gastro-enteritis, for which the accused claimed that he was treating her.

3. *Case of Criminal Abortion—Retention of a Piece of Gum-Elastic Bougie for More than Eleven Months. Brit Med. Journ., June*, 1894, *p.* 1,187 (Sykes-Ward).—The patient consulted Dr. Sykes-Ward about a sinus situated over the sacrum which had been discharging for over six months. There was a purulent discharge from the vagina and on examination a foreign body was felt partly in the vagina and partly in the uterus. The vaginal portion was bent round and rested on the posterior wall. It was removed with considerable difficulty and proved to be a piece of gum-elastic bougie five and one-half inches long. There was no evidence of perimetric inflammation or implication of neighboring viscera. The patient admitted that the bougie had been introduced by a woman who is now undergoing penal servitude for procuring abortion in another case. The bougie was inserted on November 3d, 1893; she miscarried two days later, and suffered from pain in the back and purulent discharge from the vagina up to April, 1893, when the sinus began to discharge. She recovered completely in a fortnight after the removal of the bougie. It must have been so tightly wedged in the uterine tissue that it did not come away when the abortion took place.

4. *Case of Criminal Abortion by Means of Tartar Emetic.* "*Avortement Criminel démontré au bout de plusieurs Mois par le Diagnostic retrospectif de la Grossesse,*" *Lyon*, 1887 (Fochier and Coutagne).—Caroline B., pregnant about four months, was taken by

her lover to an abortionist. On three days consecutively a powder of antim. tart. (probably ten centigrammes each) was administered, followed by violent and repeated vomiting without colic or diarrhœa. An infusion of powdered red madder, which is used commonly by the lower classes in Lyons as an abortifacient, was administered several times. Once a concentrated infusion of absinthe was given, followed in three days by abortion. The only efficient one of these remedies was the tartar emetic, whose action was due to the mechanical effect of severe vomiting. It was suspected that these potions were supplemented by some direct interference with the uterus. This case is well worthy careful study from the thorough and efficient way in which the medical investigation was carried out.

5. *Fatal Case of Phosphorus-Poisoning and Abortion. Vierteljahrssch. f. ger. Med.*, 1893, *vi.*, *p.* 280 (Seydel).—On November 2d, 1892, a woman well advanced in pregnancy was brought to the Königsburg lying-in hospital, with skin and conjunctiva markedly icteroid, gums and buccal mucous membrane covered with numerous punctiform blood-spots and saliva mixed with blood. She was tender on pressure in various parts of the body—urine dark-red and containing blood and bile-pigment. The following morning, on attempting to get out of bed to urinate, she fell unconscious on the floor. Hemorrhagic patches the size of the palm appeared on left thigh and right knee as result of the fall. A similar patch appeared on upper left eyelid. In the afternoon of the same day, two dead twins were spontaneously delivered. There was moderately severe hemorrhage, and after the separation of the second placenta the patient died, retaining consciousness to the very last. Subsequent investigation showed that she had soaked probably one hundred matches in water and drunk the fluid on the evening of the 28th October. The first symptoms were observed on the following morning, severe vomiting, complete loss of appetite, so that thenceforth she only took water. Nevertheless she tried to do her work on the 30th and 31st, and went to her mother's house in the same village on the evening of the 31st. The clinical signs of phosphorus-poisoning, great prostration and muscular weakness, a small frequent pulse and weak heart-beat, were present and necessitated lying in bed till the time of her death. The vomiting was not very excessive or frequent. On post-mortem examination the liver was found very fatty, the cells of the acini generally being filled with fat-drops. The kidneys also showed advanced fatty degeneration of the epithelium of the uriniferous tubules, while the glomeruli were but little affected and showed no signs of necrosis. Fatty changes not much advanced in the heart-muscle. The twins were about the twenty-fifth to twenty-seventh week. Macroscopically there were no special changes in the organs except bleeding on the cranial bones and in the brain, and extravasations of blood in the serous cavities. Microscopic examina-

tion showed no special change in heart and kidneys, but in the liver there was scarcely a cell without large fat-drops. Compare Miura's experiments upon animals (Virchow's *Archiv*, xcvi.)

6. *Fatal Case of Criminal Abortion by Vaginal Injections. Annales d'Hygiène Publique, Jan.*, 1893, *p.* 71. The celebrated Thomas case (Vibert).—In Paris the woman Thomas throve for several years as an abortionist and gained wide reputation for her ability and success. Her method was to pass a canula into the cervix or high up into the vagina, and inject water or some infusion. She did not use a speculum nor did she guide the canula with the other hand, but carried it directly to the top of the vagina with one hand, adjusted it in a minute or two, and then gave the injection. The whole operation including the injection did not last on the average more than five minutes, and was painless according to the testimony of her patients. Although there was no local pain, yet there was sometimes immediately set up a state of general malaise together with symptoms indicative of profound disturbances of the nervous system. At last a fatal case occurred, and investigation exposed the extent and method of her operations. A healthy, vigorous, well-formed young woman, about four and a half months pregnant, applied to Thomas for an abortion. In the presence of another woman, a canula was passed with one hand into the vagina without the aid of a speculum. The accused was preparing to inject water through the canula when the patient complained of great malaise, slipped down on the floor, lost consciousness, groaned several times without being able to speak, and died in a few minutes. Death can be explained only by reflex action by inhibition of the nervous system provoked by excitation of the cervix. No doubt this is rare, but Vibert subsequently hunted up seventy-two women who had been operated on by the accused, and examined them carefully; of the number, six others during the injection or immediately after were seized with faintness, dizziness, vomiting, etc., which generally lasted some hours and then disappeared without leaving any trace. Those reflex symptoms came more rapidly in some cases than in others. In the fatal case, they came the moment the canula was introduced, in others during the injection of the fluid, and in others not till some minutes afterward. More than nine-tenths of the patients had no such symptoms. The quantity of liquid seemed to make no difference, nor the number of times the injection was repeated. In the fatal case there had been great haste, excitement, and heat after a hearty meal: the condition of digestion no doubt played an important part. In more than half of the cases, flow of blood began within twenty-four hours, most frequently in six to eight hours. In five cases it began in one hour. Sometimes it did not begin for ten to fifteen days or even upward of a month. Cramps and pain in the back soon followed the flow of blood. Only four or five were ill or feverish enough to be forced to

stay in bed for a few days—but about one-fourth of the women were found to be suffering from metritis with well-marked objective signs. With regard to the number of injections required to bring on abortion, Vibert found one woman who was injected twenty times in the same pregnancy, another eleven times, one eight times, one five times, five four times, three three times, twenty-one two times, and forty-three once.

7. *Abortion by means of a Seton-Needle Introduced into the Uterus. Archiv. Gén. de Méd., Paris*, 1823, iii., 80–83 (Crouzit).—A young woman had been bled several times and freely to produce abortion, but without effect. A seton-needle six inches long was then passed into the uterus so far that it could not be withdrawn. The operator assured the patient it would come away with the fœtus. It did not do so, however. After suffering severe septic symptoms pain was felt in the inguinal region about the thirty-fifth day: a painful swelling formed, and finally on the seventy-ninth day the needle was discharged from the groin.

8. *Fatal Case of Abortion Following the Introduction of a Piece of Wood into the Uterus. Méd. Lég.*, 1829, *p.* 329 (Smith).—A woman about six months pregnant applied to a midwife for an abortion. A sharpened piece of wood was pushed up into the uterine cavity. A living child was eventually born, but the mother died soon after. At the post-mortem a number of tears and perforations were found in the uterus, about which gangrenous inflammation had been set up.

9. *Fatal Case of Abortion—Perforation of the Uterus. Archives d'Anthrop. Crim. et des Sciences Pénales*, 1889 (Lacassagne).—A woman, æt. 40, died at Lyons on April 9th, 1889, under suspicious circumstances. The body was exhumed and examined on April 27th. The liver, spleen, and kidneys were much decomposed, the uterus comparatively fresh. In the middle of the fundus uteri was an opening with tolerably regular borders, 34 mm. long, corresponding to the transverse diameter of the uterus, and 11 mm. broad, terminating at the right in a notch. The anterior part of the uterus was red and blackish in certain parts. The left ovary and broad ligament were large and infiltrated with blood. A corpus luteum in left ovary. On cutting into the uterus, it was found to be enlarged like a pregnant uterus, but there was no sign of ovum or fœtus. Three little tumors were found on the mucous membrane, one the size of a cherry-stone, which contained blood. About the perforation, the edges were ragged and the uterine parietes were eroded in a cone-shaped manner, the base corresponding to the mucous membrane. The product of conception was not found in the abdominal cavity. The opinion was given that the woman had been about two and one-half months pregnant; that an abortion had been produced by the introduction of some instrument, that the fundus had been perforated thereby, and that death had occurred on the fifth day from metro-peritonitis. Spontaneous rupture of the uterus could be absolutely excluded.

10. *Induced Abortion, Perforation of the Uterus without Peritonitis. N. Y. Med. Record, vol. l., p.* 246 (Gould).—There was removed from the uterus of a 36-year-old woman, on whom criminal abortion had been produced three weeks previously, a knitting-needle 6 cm. long, whose upper end could be felt through the abdominal wall below the umbilicus, at which point an abscess had formed. The case is interesting because of the absence of the slightest signs of peritonitis or septicæmia.

11. *Acute Alcoholic Poisoning, Abortion, and Death Following the Drinking of a Bottle of Brandy. Archiv. de Tocologie, vol. xxiii.*, p. 476 (Drappier).—A woman six months pregnant drank a litre of brandy; twenty hours later, twins were expelled, and in forty hours more the woman died comatose. Abortion was caused by her blood surcharged with CO_2 exciting powerful uterine contractions.

12. *Abortion Produced by Means of a Catheter Passed into the Uterus—Removal of the Catheter Two and One-half Years afterwards. Nederl. Tijdschr. v. Verlosk. en Gyn.*, 1899, *p.* 57 (Smitt).—A midwife produced abortion by passing a sound into the uterus. The catheter did not come away. Abdominal section was done two and one-half years later for the removal of a tumor which could be felt near the uterus. The tumor was found to be the catheter surrounded by a coil of intestine. There were no adhesions between the uterus and intestine.

13. *Perforation of the Uterus by a Knitting-needle Introduced by a Woman into Her Uterus—Septicœmia and Total Vaginal Extirpation. Wien. Med. Presse, Bd.* 39, *p.* 965 (Murmayor).—A woman, thinking herself pregnant, passed a wooden knitting-needle into her uterus to provoke abortion. A physician, unaware of what had been done, practised uterine massage, on the conclusion of which the woman complained of great pain. On account of subsequent suppuration and septic infection, the uterus was removed completely *per vaginam*, and the needle was found protruding 1 mm. from the fundus. The question was left open whether the needle had been pushed through the fundus by the woman herself, or whether it had only penetrated the uterine wall and subsequently worked through, or whether it had been forced through during the massage.

14. *Abortion Produced by Taking Diachylon Plaster in the Form of Pills—Death. Lancet*, 1898, *vol. ii., pp.* 159 *and* 255 (Crooke).—Diachylon plaster was taken in pill form for several weeks. Abortion was followed by convulsions, coma, and death. The autopsy showed acute lead-poisoning and a recently emptied uterus. It seems that diachylon plaster is often used in Birmingham as an abortifacient, and several other fatal cases have been reported.

15. *Sudden Death from Syncope during an Attempt to Produce Abortion by an Intrauterine Injection. Semaine Gyn. Inn. et*

Annales d'Hygiene pub. et de Méd. lég., Juillet, 1896 (De la Touche). —While a midwife was injecting a solution of soap and salt into the uterus to provoke abortion, the patient suddenly collapsed and died. The autopsy showed no injury to the uterus, no peritonitis; only the lower portion of the ovum was detached, the placental side was uninjured. Death was caused in a reflex way by syncope.

16. *Fatal Criminal Abortion by Electricity. Boston Med. and Surg. Journal, vol. cxxxiv., p.* 429 (Draper).—A "magnetizer" produced abortion by means of electricity One pole was applied intravaginally. The woman died of purulent peritonitis eleven days after the operation. The autopsy showed an ulcer on the anterior and posterior walls of the os int., with ragged borders and dark-colored base, probably caused by the erosion of the electrode. The placenta was *in utero.* Bleeding began the day following the operation.

17. *A Fœtus Expelled through the Posterior Wall of the Cervix Instead of through the Os. Thèse de Paris*, 1903, 1002–3, *No.* 218 (Escaude).—In the Hôpital Tenon a five-months-old fœtus was expelled, not through the os, but through a tear in the posterior wall of the cervix. This case is interesting, because the virginal appearance of the os is not necessarily a proof that the uterus has not contained a fairly large fœtus. It emphasizes also the necessity of making a minute and careful examination of the passages in cases of suspected criminal abortion.

18. *Nutmeg as a Poison and Abortifacient. Squibb's Ephemeris, vol. vii., No.* 1, 1903.—A young woman whose menses were delayed a fortnight took a whole nutmeg, grated, in a wineglassful of gin at bedtime, hoping thereby to bring on her courses. In a couple of hours she was found in a collapsed condition and muttering unintelligibly; her extremities were clammy, pulse hardly perceptible, pupils somewhat dilated and reacted feebly to light. The stomach was washed out, and after a few hours more of muttering delirium she sank into a heavy sleep from which she awoke apparently recovered. The catamenia followed, accompanied by much pain. Nutmeg seems to be highly esteemed as an emmenagogue in the North of England, and belief in its efficacy has been carried by domestic servants to Australia and America. Dr. S. Maberly Smith, of Geelong, Victoria, Australia, reports a similar case (*Lancet*, 1902, *vol. i., p.* 1798). A woman took a whole nutmeg ground up and mixed with gin to produce abortion, and nearly died from the effects, with symptoms of narcotic poisoning. A neighbor had nearly died from the same cause shortly before. One old lady in the community said that the abortifacient properties of nutmeg were well known in the North of England, whence she had come. Squire states that nutmeg in large doses is a narcotic poison.

INFANTICIDE.

GENERAL CONSIDERATIONS.

INFANTICIDE means the murder of a new-born child. It is not a specific crime under the English law, but comes under the same rules as other forms of murder. In order that a charge of infanticide may hold, the child must be new-born, must be alive when criminal violence is used, and must die from the effects thereof. It matters not whether the child lives for minutes, hours, or days; infanticide holds if its life is destroyed after its birth. To substantiate such a charge, the law requires satisfactory proof that the child lived after complete birth, and that its death was due to criminal violence. The fact of live-birth must be clearly proved by the prosecution, otherwise the law assumes the child to have been dead-born and the charge of infanticide will not hold. In other words, the law assumes all children to have been born dead, unless it can be proved that they were born alive; the onus of proof rests on the prosecution. Furthermore, it is not enough to prove that the child was alive when violence was used, and that death ensued therefrom; it must be clearly established that the fatal violence was inflicted *after* birth. It is evident, therefore, that in cases of infanticide much depends upon the medical evidence. The medical expert is generally the most important witness, and a great deal is expected of him, far more sometimes than he is able to perform. In giving evidence, he should confine himself strictly to the medical aspects of the case, laying before the court a full and clear statement of the appearances he has observed, and the conclusions fairly deducible therefrom. The legal bearings and the interpretation of the facts are entirely out of his province and should therefore be avoided. He is not trying the case, nor is he responsible for the conviction and punishment or the acquittal of the accused; these are the duties of judge and jury with which he has nothing to do, and with which he should not interfere. Legal enactments vary in different countries, and at different times in the same country; the same law is sometimes interpreted differently by different judges. The legal point of view may vary considerably;[1] the scientific point of view with which the medical man has chiefly to do, is subject to less variation. His duty is to enlighten the court as to the medical facts of the case, and his testimony forms but one link in the chain of evidence. It is, therefore, safer and wiser for him to confine himself to his own province. In cases of infanticide the medical witness is called upon to assist in solving the four following questions:

1. Was the child born alive?
2. If so, how long did it live after birth?
3. Was death due to natural causes or to violence?
4. Was the violence accidental or criminal?

I. WAS THE CHILD BORN ALIVE?

The question of live-birth is a very important one, both from its criminal and civil bearings. In *criminal* courts charges of concealment of birth or infanticide, in *civil* courts questions of inheritance, tenancy by curtesy, the disposition of property, etc., may depend upon whether a child was born alive or dead. Here at once confusion is apt to arise from differences in the medical and legal definitions of live-birth. The law must lay down arbitrary lines for its own guidance with which the medical witness must not interfere. From his point of view life begins with conception and continues until terminated naturally or by violence. Birth is merely the expulsion of the child from its mother's body, and from the scientific standpoint has no necessary connection with the life or death of the child. If for the sake of convenience, or as the reflex of opinion, usage, or custom, the law declares that a child must be completely extruded from its mother's body before its destruction can be called murder, or that it must have breathed and cried, or that it must have had an existence independent of its mother, the question of live-birth from the scientific standpoint is not affected thereby. These are mere arbitrary conditions which may vary in the penal codes of different countries, or may be modified or altered from time to time. The law must have broad principles of action to enable it to grade and classify crimes and apportion fitting punishment. With such matters the medical witness has nothing whatever to do. He will save himself annoyance and further the ends of justice if he confines himself to the scientific aspects of the case, laying the medical facts before the court and leaving it to interpret the law and use his evidence in whatever way it deems proper. If the law of the land as interpreted by the courts requires as proof of live-birth that the child has cried, moved, or breathed after being completely extruded from its mother's body, it is obviously useless and needless for the medical witness to contend that in his opinion the child lived after its birth because he observed something else which the law does not recognize as a proof of live-birth. It is quite sufficient for him to state what he did observe and the conclusions he has drawn therefrom leaving the court to use his evidence along with all the other evidence elicited in the case in coming to a conclusion. Controversies respecting what should constitute proof of live-birth are right and proper in medical societies and journals, but quite out of order in a court of law.[1] The medical witness is not in court to impeach the law or prove that its findings are wrong. Attention to this matter would greatly simplify medical evidence in cases of infanticide and prevent much unnecessary friction.

---

[1] The Austrian statutes distinguish between legitimacy and illegitimacy in estimating guilt. A woman who destroys a legitimate child is considered more guilty than one who destroys an illegitimate one.

Although the English law does not define live-birth, yet the decisions and rulings of the courts are fairly clear. In the eye of the law, a child has been born alive, if there has been "the manifestation of some certain sign or signs of life after it is completely born." No particular sign of life is required, nor even evidence of independent life; two conditions only are essential: (1) Complete extrusion of the child from its mother's body, and (2) some certain sign of life. All the judges agree that the child must be completely delivered, before it can be considered as legally born. From the scientific standpoint it does seem absurd to hold that a child is not born because one foot remains in the vagina, although the rest of its body has been lying for some time in the bed and it has been breathing or crying. Yet such is the law, and if the child is murdered before the foot is completely extruded from the maternal passages, the charge of infanticide will not hold.[1] It is always hard for a medical witness to swear positively that the child was completely born before it was assaulted, unless he was present himself, and miscarriage of justice has repeatedly occurred from inability to establish complete birth in the legal sense. The date of birth is the moment of complete delivery. Tidy mentions a case where the head was born one minute before midnight on December 31st, 1799, but the body was not completely born till one minute after midnight; that child's birthday was January 1st, 1800. In cases of twins or triplets, the eldest is the one which is first completely born, although previously another may have been partially born.[1]

---

[1] Professor Glaister has made a strong appeal for the revision of the English law concerning infanticide, pointing out its discrepancies and absurdities, and calling attention to the startling fact that the killing of a child in the act of birth or before it is fully born is not an offence under the present law. He gives an interesting historical review of the legislation on this subject (Edin. Med. Journal, xli., p. 1).

---

[1] In 1893 Viscount Grimstone asked in the House of Commons a return of the still-births in England and other countries. This was tabled on May 9th, and ordered to be printed on June 21st. Although the main object was to find out the practice of other countries regarding registration of still-births, other questions were put. Among these was, "What are the penalties for criminally causing a child to be still-born?" The answer from the criminal authorities of England is important; it is as follows: "For procuring abortion, the punishment is penal servitude for life; or for any less term, or imprisonment. Where there is no procuring of abortion, *the killing of a child in the act of birth and before it is fully born is not an offence by the present law*, although if injuries are inflicted before birth which cause the child's death after birth, the law of murder applies." Apparently, as the English law now stands, if a parturient mother or any other person destroy a child while it is being born and before complete delivery is effected, such person is not chargeable with any offence against law.

In Canada the criminal law has been codified, and the defect in the English law has been remedied in section 271, which reads as follows:

271. *Killing Unborn Child.*—Every one is guilty of an indictable offence and liable to imprisonment for life who causes the death of any child which has not become a human being, in such a manner that he would have been guilty of murder if such child had been born.

2. No one is guilty of any offence who, by means which he in good faith considers necessary for the preservation of the life of the mother of the child, causes the death of any such child before or during its birth.

"This section will meet the case of any wilful and unlawful killing of a child which, in consequence of the injuries inflicted upon it, becomes extinct either while it is still in the womb or while it is proceeding but has not yet completely proceeded from its mother's body. By section 219, a child only becomes a human being when it has completely proceeded in a living state from the body of its mother; and it is not homicide to kill a child which becomes extinct before it has so become a human being.

"Subsection 2 of the above section 271 is meant for the protection of medical men who, acting in good faith, in the course of their professional practice, find it necessary either to induce premature labor so as to save both mother and child, or, in extreme cases, to kill, during or before labor, the unborn child, in order to save the life of the mother" (Criminal Code of Canada, 2d ed., 1902, p. 281).

According to English law the second essential condition of live-birth is the existence of some certain sign of life—the pulsation of the cord, the beating of the child's heart (either seen, heard or felt), motions of the limbs, twitchings of the muscles, wrinkling of the brows, puckering of the face, opening of the eyes, have all been considered proofs of live-birth, although respiration did not take place. In a case which came under my own observation the breech presented and the labor was tedious and difficult. Immediately after birth the fœtal heart-beat could not be made out by auscultation, the cord had ceased to pulsate, there was no attempt at respiration, and the only sign of life was that the child opened its eyes a couple of times. It was not resuscitated, but was held to have been born alive. A moment of life after birth gives the same rights as hours or days.

When a woman is accused of infanticide, she should be examined, if possible, to determine whether she has been recently delivered. The medical witness should remember that such an examination cannot be made without her consent. He may lay himself open to an action for assault if he forces an examination against her will. A woman who is accused of murder cannot justly be forced to furnish evidence for her own conviction. Neither coroner, magistrate, nor police can give a physician the legal right to examine a woman against her will, no matter whether she is eventually proved to be innocent or guilty; she must give her free consent to make the examination legal. The coroner can give an order for the examination of a dead body, but not a living woman. (See EXAMINATION OF THE LIVING, this volume, pp. 495–504.)

The evidence obtainable to substantiate the presence or absence of live-birth may be conveniently considered in two classifications:

---

[1] In twin cases, midwives and nurses sometimes tie a string or ribbon around an arm or foot which has come down first into the vagina, to determine which child is the elder. This practice is not in accordance with the law, and may do serious injustice if inheritance depends upon primogeniture.

I. Evidence of life or death obtainable immediately after birth.

II. Evidence of life or death obtainable from a post-mortem examination.

I. Evidence Obtainable Immediately After Birth.

If any sign of life was noted the proof is positive; but the fact that no such sign was noted is no proof that life did not exist. Mere heat of body is not a sign of life, because the child when born has at least the same temperature as its mother's body. Cadaveric rigidity is not a sign that live-birth took place.

Fœtal Heart-Beat and Pulsation of Cord.—If the fœtal heart can be seen, felt, or heard beating, or if the cord is still pulsating, the child is alive. As long as circulation goes on, it is possible to establish respiration; but when the heart ceases to beat life ceases. The heart-beat is therefore the ultimate test of life. But its apparent absence is not a proof of death, for it may be beating so feebly or so slowly that it cannot be heard or felt.

The feebler and more immature the child, the longer may its heart keep on beating feebly, provided respiration is not established. Bouchut records a case where the heart-beats were audible for twenty-three hours after birth, although there was no sign of respiration during that time.

The length of time that apparently dead-born children may survive is sometimes remarkable. Cases are recorded where they have been buried and afterward dug up and resuscitated.

Champneys[1] mentions a case reported by Dr. Roper where a child was dissected the day after still-birth and the heart was found beating. Another child born at five and one-half months was thought to be dead and left on the floor for eleven hours on a cold night; in the morning it was found to be alive.[1] Two illegitimate children were buried and resuscitated after several hours. Another was buried for five hours, restored to life, and lived for three days (Bohn). Another was for eight hours buried in a field, 25 cm. below the surface of the ground; it was disinterred and lived four days (Bardinet). Maschka reports a case where a child apparently dead-born was coffined after attempts to resuscitate it had failed; twenty-three hours after birth the heart-beat was audible with the stethoscope, though all efforts to revive it failed. Such cases show how careful the attendant should be in pronouncing upon the death of new-born infants.

---

[1] Champneys: "Experimental Researches in Artificial Respiration in Still-born Children," 1887, p. 134.

Muscular Movements.—Slight movements of the limbs, twitchings of the eyelids, wrinkling of the brows, puckering of the face, sucking movements of the mouth, especially if the finger is put beween the lips or on the tongue, opening of the eyes, or any independent muscular movement on the part of the child occurring after complete delivery, must be accepted as proof of life. But the evidence of unskilled observers should be received with caution, as they are apt to be deceived.

Crying is a positive proof of life but not necessarily of live-birth, for the child may cry before being completely born. In delicate, feeble, or immature children crying may be absent, or so feeble as to be heard only by those close at hand; in the confusion, bustle, or excitement at the time of birth the child's cry might be easily overlooked.

It is possible for the child to cry in utero, or while passing through the vagina or vulva, and perish before being completely born. This can happen only after rupture of the membranes, and is rendered possible by air finding its way into the vagina or uterus and reaching the child's mouth and nose. Professor Holmes,[2] of McGill University, Montreal, reported a remarkable case of this kind in the *Edinburgh Medical and Surgical Journal.* (See case 32.) Similar cases have been recorded and are mentioned by Ogston,[3] Taylor, and Tidy.[4] S. Marx attempted to deliver in a case of contracted pelvis by introducing the hand

---

[1] Lancet, Nov. 27th, 1880, p. 852.

[2] Edin. Med. and Surg. Journal, xxxiii., 1830, p. 215. For details see report at end of this article.

[3] Ogston's "Med. Jurisp.," 1878, p. 247 *et seq.*

[4] Tidy's "Legal Medicine," Am. ed., 1884, vol. iii., pp. 156, 179, 180.

and seizing a leg. He heard the child's muffled cry during the manœuvre; it was born asphyxiated and could not be revived. Collyer heard a child cry while traction was being made with forceps; version was at once performed, but the child was born dead. Grandin[1] heard the child cry in utero while he was performing version. The child was large and the pelvis contracted. As the foot appeared at the vulva a distinct cry was heard like that of an angry child, and was repeated whenever the foot was pulled; the head was at that time in the upper uterine segment. The crying was distinctly heard by Drs. Grandin and Sims and two nurses who were present in the room; it ceased as soon as the trunk was delivered. The child was born asphyxiated, but as there was no liquor amnii or mucus in the respiratory passages it was soon resuscitated.

On the other hand, the child may live for hours or days before it utters a cry; this is most apt to occur in premature children, and is due to debility. Ogston claims that if the lungs show signs of having fully respired, the child has in all probability cried. In order that crying may be accepted as a proof of live-birth, it must be shown to have taken place after the child was completely born.

In trials for infanticide the evidence respecting the child's cry may take several forms. Testimony may be offered that the cry was actually heard by persons who were in the room at the time, and they had ascertained that the child was or was not completely born. Or it may be proved that no cry was heard by any one who was present at the time of the birth, and that it would have been impossible for it not to have been heard if the child had cried after its birth.

Breathing.—The slightest gasp or attempt to breathe is a positive proof of life; but the child may breathe, as it may cry, any time after the rupture of the membranes, either in the uterus or in the process of birth. Breathing is consequently a sign of life but not necessarily of live-birth. On the other hand, absence of breathing does not necessarily mean absence of life. The child may breathe in utero (vagitus uterinus), if air has entered the uterine cavity and the respiratory centre in the medulla has been prematurely stimulated by the accumulation of CO_2 in the blood. This accident is most likely to happen in face presentations when the mouth lies over the os uteri, or during attempts to deliver by forceps or version. The evidence of the medical attendant would be conclusive in such cases, and the criminal destruction of the child by its mother during or after birth would be improbable or impossible. Breathing may occur while the head is passing through the vagina (vagitus vaginalis); this accident is also rare, and presupposes a small child or roomy pelvis and vagina, with access of air.

---

[1] New York Journ. of Gyn. and Obst., April, 1894.

More frequent than either of these is the occurrence of breathing while the head is protruding from the vulva. In such a case there would be little or no obstruction to the entrance of air into the lungs, and the maternal passages would not compress the child's body sufficiently to prevent the action of the respiratory muscles. It would be reasonable to suppose that the child would be born alive unless it was subjected to some violence before the rest of its body was delivered.

The medical witness has no means of distinguishing between breathing which occurs when the head is protruding from the vulva, and breathing after complete delivery. Yet there is an important distinction from the legal point of view, and the whole case may turn upon the ability to make this point.

Still-Birth.—Some confusion exists respecting the meaning of this term, and it has been very generally confounded with dead-birth. A child is *dead-born*, if it is dead when completely born. It is *live-born* if there is any sign of life after it is completely born. It is *still-born* if it is *live-born* but makes no attempt to breathe and finally dies without respiration having been established. *Still-born* children are always *live-born*, and the term still-born ceases to be applicable after the first gasp for breath. It is, therefore, incorrect to designate or certify as *still-born*, those children which have breathed and lived feebly for a few minutes, hours, or days.

Maceration or putrefaction positively proves death before birth, if found present a short time after birth. No conclusion can be drawn if there has been sufficient time for putrefaction to become far advanced. When the fœtus perishes in utero, it *macerates* if it remains for some time surrounded with liquor amnii and air does not gain access to it. It *putrefies* if air reaches it, bearing the micro-organisms which cause putrefaction.

In maceration the epidermis is first affected. Numerous blebs or vesicles form between the cutis and the corium; these blebs resemble pemphigus, and contain a red serous or serosanguineous fluid. They usually begin to form about three days after the death of the fœtus. The corium is infiltrated and becomes brownish-red. The epidermis is easily detached and comes away in flakes. There is œdema, most marked over the head, hands, feet, abdomen, and sternum. The body is flaccid and usually distorted in appearance, swollen in some parts, depressed or unchanged in others. The cranial sutures are separated and the bones freely movable, the head feeling often like a loose bag of bones. The brain becomes grayish, red, and pulpy. The joints are sometimes disarticulated, and the periosteum detached from the long bones. The serous cavities fill with serosanguinolent fluid and the blood-vessels with dark grumous blood. All the viscera are infiltrated and friable, the uterus and lungs remaining longest unaffected. There is a disagreeable sweetish odor, quite different from the offensive smell of putrefaction. The longer the fœtus has remained dead in utero, the more pronounced are the signs of maceration. The microscopic appearances of the tissues are characteristic. Lempereur distinguishes three stages of maceration: (1) From the 1st to 10th day, (2) from the 10th to 40th, (3) from the 40th to 60th. Sentex describes minutely the progress of maceration from day to day.[1]

Grave mistakes have arisen from want of care in distinguishing the results of maceration from pathological changes; even dislocation of the joints and mobility of the cranial bones in a macerated fœtus have been mistaken for the effects of violence. It is also worthy of note that congenital pemphigus has been mistaken for the signs of maceration. Hofmann reports a case of this kind. If a macerated fœtus remains in the uterus or abdominal cavity a month or more, the blood more or less leaves the body through transudation or imbibition, and the fœtus has a bleached fatty appearance. But the striping of the muscle is distinguishable for a long time under the microscope and a careful examination enables the organs to be made out.

---

[1] Charpentier: "Traité Pratique des Accouchements," 2d ed., pp. 1,027–1,030. Maceration changes have been studied carefully and described by Lempereur, Sentex, Ruge and Martin. The two latter call a macerated fœtus, "fœtus sanguinolentus." Ruge describes F. Sanguinolentus, *cf.* Zeitschrift f. Geb., i., 57; *cf.* also Berlin. klin. Wochensch., 1882, No. 34; M. Martin (Lyon), "Mémoires de Médecine et de Chirurgie Pratique," Paris, 1835.

Putrefaction requires air, moisture, and heat. The soft parts disintegrate and decompose, evolving the characteristic putrefactive odor, which is sometimes very offensive. Gases form in the fœtal cavities, and sometimes in the uterus, producing the condition known as physometra. The fœtal subcutaneous tissues crepitate, and the abdomen may become so distended as to interfere with delivery. As a general rule, fœtor of the liquor amnii during labor and physometra are taken as signs of death or putrefaction of the fœtus. That this is not always so, is shown by the following case reported by Leblond.[1] The patient, æt. 21, entered *la Maternité de Cochin, Paris*, under Dr. Bouilly. Being at full term, labor set in and the waters came away; when she reached hospital, the liquor amnii was fœtid and the pains ceasing. During the night she had several rigors and severe abdominal pain. In the morning the stench in the ward was horrible, and on examination a small quantity of offensive black discharge was found coming from the vulva. The head presented in the first position of the vertex. The uterus was much distended and resonant on percussion toward the fundus; the skin was hot and pulse rapid (140). Forceps were applied at once and a well-formed living child extracted; at the same time there came away from the uterus with much noise a quantity of gas and fœtid black liquid. The cord was small and greenish; the placenta was greenish on its fœtal side, but normal on the maternal aspect; the membranes were very friable. Baudelocque had a case where the child was born alive with all the signs of intra-uterine putrefaction, but the cause was attributed to a gangrenous eschar on the top of the child's head. Fœtor and physometra are not uncommon if the membranes have been ruptured a long time before the child is born, and may be due to a decomposing clot of blood. A good summary of the views of Siebold, Naegelé, Plouvier, Desormeaux, Deubel, etc., together with the report of a number of cases, may be found in Chatelain's[2] thesis on intra-uterine fœtal putrefaction.

---

[1] Nouvelles Arch. d'Obstétrique et de Gynécologie, 1892, vii., p. 309.

[2] Chatelain: Thèse de Paris, 1883

Intra-uterine putrefaction while the fœtus is still alive may be due to putrid decomposition of clots in the uterine cavity. Fœtor of the liquor amnii is generally caused by the entrance of air after early rupture of the membranes, and comes on very rapidly in some cases. The fœtor is sometimes not very pronounced, and may therefore be overlooked or attributed to other causes. It is not an uncommon condition and it would be very unsafe to affirm the intra-uterine death of a fœtus on the ground of the putridity of the liquor amnii, or the putrefactive changes in the sheath of the cord or the fœtal aspect of the placenta.

Mummification.—Drying up and shrivelling of the fœtus is rare and is of course a sign of intra-uterine death. It usually occurs when the fœtus dies at the third or fourth month, and no air enters the uterus. It must not be forgotten that a fœtus may mummify after birth instead of putrefying, if there is absence of moisture and other conditions are favorable.

Respiration.—Of all these signs the greatest stress medico-legally is laid upon the proof of *respiration*. In some countries and by some authorities proof of respiration is deemed essential in establishing the fact of live-birth. This view, however, is not accepted by the majority of medical jurists. Breathing and life are not synonymous, for a child may be alive and yet not have breathed. Life is wider and more comprehensive than breathing; a child that breathes must be alive, but one that is alive need not breathe. Before birth, the placenta is the fœtal lung. It is a composite organ, partly maternal and partly fœtal, by means of which the mother supplies the fœtus with oxygen and relieves it of CO_2. The fœtal heart pumps the fœtal blood to and from the placenta, and maintains the circulation in the fœtal body. The mother's heart keeps the placenta provided with sufficient maternal blood to supply the fœtal demand for oxygen, and relieve it of its waste matters. As long as the fœtal heart keeps beating the fœtus is alive, and the respiratory function is carried on more or less efficiently in the placenta. But during labor the uterine contractions compress the placenta, and interfere more or less with the supply of maternal blood; the crippled placenta then becomes less and less able to do its work and finally ceases to function altogether; CO_2 accumulating in the fœtal blood excites the medullary respiratory centre into activity, and the first gasp for breath denotes the transference of the respiratory function from placenta to lung. This gasp usually occurs immediately after birth; but sometimes it may be before or in the process of birth, or not till some time after.

If the lung is fully able to undertake its new functions, respiration becomes completely established and the child lives and thrives; but if it is unable to aerate the blood sufficiently for the maintenance of life, the child slowly asphyxiates; or if it cannot function at all, the heart soon ceases to beat and the child dies; or if there is some delay in starting respiration after birth from mechanical impediment or other cause, the preservation of the child's life may depend upon the rendering of suitable and timely assistance. The transference of the blood-aerating function from placenta to lung is therefore only a change in mechanism, a new phase in the advancing life of the fœtus. just as the development of the placenta was a distinct advance upon earlier nutritional arrangements.

It is evident, therefore, that respiration may be set up at any time, either before, during, or after birth, whenever CO_2 accumulates in the fœtal blood in sufficient quantity to excite the respiratory centre into activity. Any cause which interferes with the maternal or fœtal circulation, or produces local engorgement of the placenta, may produce this state of blood, and the fœtus may slowly asphyxiate or gasp for breath while still in utero or in the process of expulsion therefrom.

It occasionally happens that the placenta does not separate at once from its uterine attachments; in that event, a modified placental circulation continues after the child is born, and respiration may not be at once established. But when the cord is tied or divided, all vascular communication with the mother ceases, and the child must breathe or perish. If eventually it breathes, in what condition was it while it lay wholly delivered, with cord undivided and placental circulation still continuing? It was not breathing, but was it alive? If respiration is a necessary sign of life after birth, it was not alive; when then did it begin to live? If, however, respiration is not eventually established, and the fœtal heart grows weaker and weaker till it finally ceases to beat, was the child alive after its birth or not? It is obvious that the position of those who insist upon respiration as a necessary factor in live-birth, is untenable.

It is claimed by some authorities that by the term *life* the law means *independent* life, which may be carried on without the aid of the mother, and that respiration is essential for independent life. Granted, if the definition of independent life is in the legal sense only, made for convenience and not to be considered as scientifically accurate. But suppose a child born with fœtal heart beating; the cord is tied and cut, and for a time there is no breathing; the heart still beats feebly, Sylvester's method is practised, respiration is finally established, and the child's life is saved—in what condition was that child before it drew its first breath? It was completely born, separated from its mother, not dead, but yet not legally alive if respiration is to be considered an essential condition of legal life. Again, if violence is employed while the child is in that state, and respiration does not take place at all, is the crime *fœticide* or *infanticide?* These are questions of law, with which the medical witness has nothing to do, and with which, if he is wise, he will refrain from meddling. For the physician, life begins with conception and ends with the last heart-beat; circulation may exist for a short time without respiration, but respiration cannot exist without circulation. The medical witness should state plainly the appearances he has observed, leaving the legal applications and deductions to the court.

VIABILITY.

The viability of a child, that is, its ability to keep on living after its birth and to attain maturity, sometimes comes up in this connection. The more immature the child, the greater the chance of its being born dead or of its dying from natural causes. Different codes assign different periods for viability. In France the earliest period when a viable child may be born is set at 180 days (six calendar months). In Scotland it is 168 days (six lunar months). That does not imply that a child is as likely to live at 168 days in Scotland as at 180 days in France. It simply means that for convenience of administration the laws of these countries set an arbitrary time-limit for viability which happens to be different. As a matter of fact, viability in any given case depends not so much upon the actual age of the fœtus as upon the development and power of its organs and their fitness to perform their functions. It is quite possible therefore for a certain nine-months child to be less capable of living and reaching maturity than another of eight months which is stronger and possessed of a better all-round development.

II. EVIDENCE OBTAINABLE FROM A POST-MORTEM EXAMINATION.

Marks of violence, such as abrasions, burns, cuts, bruises, etc., should be carefully noted. It should be ascertained whether they occur only on one side of the body or not, also whether they might have been produced by the mother trying to deliver herself. If there are any marks about the neck, could they have been produced by a cord or ligature of any kind applied with sufficient force to impede or prevent respiration?

Changes in the Shape of the Chest and Position of the Diaphragm.—The thorax is flat before respiration is established, arched or rounded after. It has therefore been proposed by Daniel to measure the chest in order to determine live-birth; no reliance can be placed upon such measurements as a test. The diaphragm is arched and rises high up in the thorax before respiration, but becomes flattened and depressed after. This is altogether a question of degree. The change is well marked if respiration has been complete and long continued, but slight if respiration has been imperfect or of short continuance. Diaphragmatic changes therefore are useless as a test of live-birth, though they may sometimes have a certain corroborative value.

Changes in the Lungs.—The lungs undergo important changes as the result of respiration. During intra-uterine life they have no function and receive only sufficient blood for their proper growth and development. The aeration of the fœtal blood takes place in the placenta, and the full pulmonary circulation is not established. The main current of venous blood is switched off from the lungs by the ductus arteriosus and carried from the pulmonary artery directly into the aorta, whence it passes through the umbilical arteries to the placenta. In the fœtus, the lungs lie in the back part of the chest, and are small, dense, non-crepitating, and of liver-like consistence. (Fig. 1, Pl. III.) When respiration begins, the collapsed air-cells distend

EXPLANATION OF PLATE III.

FIGURE 1.—Uninflated lung of infant which died immediately after birth. Subpleural ecchymoses and sanguineous infiltration of some interlobular septa.

FIGURE 2—Lung of new-born infant, for the most part filled with air, to a less extent unexpanded; with interstitial emphysema, produced during life.

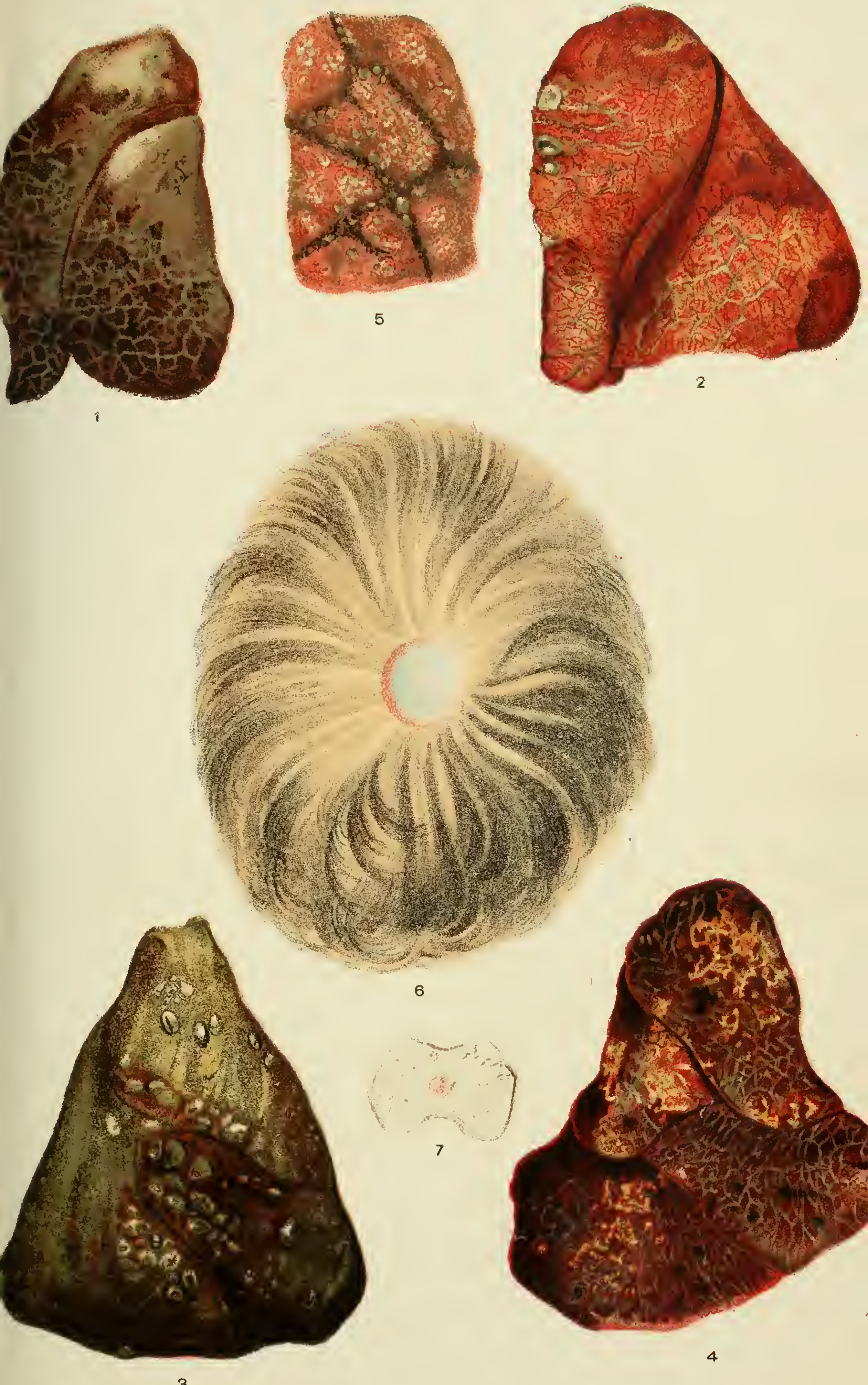
FIGURE 3.—Unaerated lung of a dead-born infant, with post-mortem discoloration and subpleural and interstitial emphysema due to putrefaction.

FIGURE 4.—Unaerated lung of a dead-born infant; with many alveoli filled with inspired liquor amnii. Subpleural ecchymoses.

FIGURE 5.—Piece of a partially aerated lung, with subpleural emphysema due to putrefaction. Magnified six times.

FIGURE 6.—Curious intra-uterine injury on the head of a new-born child—commencing cicatrization.

FIGURE 7.—Centre of ossification of the lower epiphysis of the femur of a dead-born infant at term.



INFANTILE LUNGS, Etc.

with air, the pulmonary circulation commences, and the lungs alter in volume, consistence, color, weight, and specific gravity. When the child gives its first gasp, air passes down the bronchi, distending some of the air-cells and expanding portions of the lungs, rendering them paler in color (Fig. 2, Pl. III.) crepitating, and more bulky. The deeper the respirations and the longer they continue, the more air-cells become distended and the greater the changes in the lungs. The passage from the fœtal state to that of fully developed function is a gradual process, extending sometimes over hours, days, or weeks, the rapidity depending largely upon the strength of the child and the presence of conditions favorable to respiration.

It is obvious, therefore, that the length of time a child has breathed can give only an approximate idea of the completeness of respiration and the lung changes which might be expected to be present. The first air-cells to distend are usually on the edges and concave surface of right upper lobe, and it is there that we look for the first signs of respiration. When distended with air, these cells are polygonal or angular in outline, arranged symmetrically in groups of four, though less frequently they may be irregularly scattered; they are easily distinguishable by the naked eye,[1] and vary in tint from bright vermilion to light rose-red according to the amount of blood contained in the lung. They are slightly raised above the surface and are not obliterated or displaced when the finger is rubbed over them. These appearances distinguish them from putrefactive patches and melanotic spots, but not from air-cells distended by insufflation or artificial respiration. The mottled or marbled appearance presented by groups of rose-colored spots on the dark liver-like background of fœtal lung is considered highly characteristic of natural respiration. Putrefactive patches are generally larger, and the gases can be displaced by pressure of the finger and made to move about in different directions by pressure. (Fig. 3, Pl. III.) Tardieu's method is to prick each air-bubble; if they are putrefactive the air can be all pressed out without difficulty.

The color changes are directly proportionate to the extent of expansion and the amount of aeration, not to the length of time respiration has been going on. A few full, deep breaths may change the color more than hours of feeble superficial breathing. More or less rose-color may be developed by exposing the lungs to air after death, but dilatation of the air-cells can only be effected by the entrance of air through the bronchi; no amount of post-mortem exposure will distend the air-cells. As a rule the anterior portions of the lungs show the color changes better than the posterior portions, which are apt to contain more blood from hypostasis. For the same reason anæmic lungs are lighter colored than congested ones.

---

[1] A lens of low power is sometimes of great assistance in doubtful cases.

Sometimes the lungs of children suffocated shortly after birth can scarcely be distinguished from those in which suffocation took place before birth; yet on close examination a small quantity of air may generally be discovered symmetrically distributed through the air-cells, although the color may be practically the same.

It follows therefore that dark-colored lungs are not always airless, neither do light-colored lungs always contain air. Fœtal lungs cut like liver and frothless blood exudes; lungs which have breathed crepitate on section and frothy blood exudes.

Static Test.—Absolute Weight of the Lungs (Fodéré's or Schmidt's Test).—When respiration begins the blood is diverted from the placenta and directed along the pulmonary arteries to the lungs, which fill with blood and become heavier. It has been suggested that evidence of live-birth might be obtained by comparing the weight of the lungs in any given case with the standard weight of lungs which have not breathed. In order to do this, ligatures are placed about the pulmonary vessels to prevent the escape of blood, the lungs are then carefully separated from the heart and thymus gland, removed along with the trachea and bronchi, and weighed.

The average weight before respiration is variously estimated at 430 to 649 grains. The weight of lungs which have breathed depends upon the extent and long continuance of respiration, the completeness with which the pulmonary circulation has been established, and the amount of blood drawn into the lungs. In feeble, premature children or those which have breathed imperfectly, less blood enters the lungs than in strong, full-term children or those which have breathed freely and for some time.

New-born children vary in weight ordinarily from three to twelve pounds; the weight of the lungs may be expected to vary in proportion to the weight and development of the child. It is quite possible therefore for the lungs of a large child which has not breathed to weigh more than those of a small child which has breathed.

So many sources of error have to be guarded against that this test cannot be relied upon as a test of live-birth, and can be assigned only a relative value.

Relative Weight of the Lungs to the Weight of the Body (Ploucquet's Test).—It was claimed by Ploucquet and his followers that the relative weight of lungs to body is 1:70 before respiration, and 1:35 after respiration. No value is now attached to this test, as it is admitted that no constant relation exists between the lung-weight and body-weight of children, either before or after respiration.

Specific Gravity (Hydrostatic Test).—The specific gravity of the lungs before respiration is variously estimated at 1040 to 1056; after respiration it is 940, the reduction being due to the presence of air. Lungs in the fœtal condition sink in water, those containing sufficient air float.

The method of applying the test is as follows: After securing the larger vessels,[1] remove the heart and lungs entire, place them in a vessel of water at a temperature of about 60° F. (15° C.), and note whether they sink or float. If they sink, note whether they do so partially or completely, slowly or rapidly; if they float, whether they do so high above the level of the water, on the level, or slightly below the level. If both sink, separate them and try them one at a time, because the right lung may float while the left one sinks, or the right may sink more slowly and to less depth than the left. If both sink separately, cut each into twelve to twenty pieces, and test each of these in the same manner. If any pieces float, squeeze them separately between thumb and finger under water and note whether any little bubbles of air are given off, and whether the pieces still float. Béclard exerts pressure in a different way. He wraps the pieces which float in a cloth, places them on the floor, covers them with a board and puts a heavy weight on the board, or stands upon it, thus applying a uniform, even pressure to all the pieces; he then puts them once more into water and notes whether they still float. Vibert directs the pieces of lung to be squeezed as forcibly as possible between thumb and finger under water; he lays great stress upon the fine bubbles which rise, not larger than pinheads, in a sort of fine foam. He says a positive opinion can hardly be given, if putrefaction is well advanced.

---

[1] German medical jurists ligature the trachea; the French do not consider it necessary to do so.

If the lungs sink separately and in pieces, there is no evidence that respiration has taken place. If some pieces float, the child has probably breathed imperfectly; if the lungs float separately or *en masse*, respiration has been pretty thoroughly established. Sinking denotes absence of air; floating denotes presence of air and is usually presumptive of respiration.

Upon the amount of air contained in the lungs an opinion is based respecting the completeness of respiration or the length of time it has continued. If all the pieces float before and after being squeezed or compressed, respiration was probably complete and lasted for some time; if some sink while others float, the respiration was less perfect or lasted only a shorter time.

The hydrostatic test therefore proves the presence or absence of air in the lungs, and justifies an opinion as to the probability or otherwise of respiration having taken place and the degree of perfection to which it attained. It is not an absolute test of live-birth, for the child may have been born alive and not have breathed, or it may have breathed so imperfectly that no appreciable distention of the air-cells can be demonstrated post mortem, or air may have entered some cells for a time and have been absorbed or aspirated out before death took place, leaving the lungs as airless as in the fœtal state. On the other hand the child may have breathed during its birth and died before it was completely born. The charge of infanticide may hold even when the hydrostatic test gives no evidence of respiration, or it may fall through even though the hydrostatic test proves respiration to have taken place.

Objections to the Hydrostatic Test.—1. The lungs of children which have breathed may sink from (*a*) atelectasis, (*b*) disease.

2. The lungs of children which have not breathed may float from (*a*) artificial inflation and respiration, (*b*) the presence of putrefactive gases, (*c*) emphysema.

1. Lungs which have Breathed may Sink.—*a. Atelectasis*: The lungs remain almost or wholly in the fœtal condition. In Albert's[1] case, the child lived for thirty-six hours and had several convulsions. Post mortem the whole of the right and the lower portion of the left lung were in a fœtal condition and sank in water. There was no disease present, and the unexpanded portions could be easily inflated.

Or there may be complete non-expansion although the child has lived and breathed feebly. This is most apt to occur in premature children. Remer[2] reports a case in which the lungs sank in water, although the child had lived four days and the cord had separated naturally. Orfila describes a post mortem on a child which had lived for eleven hours; every portion of the lungs sank in water. Vernon[3] was called to a woman at the end of her sixth month; when he entered the room he heard the child crying under the bed-clothes. After it was separated from the mother, it apparently breathed naturally and cried at intervals, but died in five hours from exhaustion. It weighed 2 pounds 13 ounces; the lungs were non-crepitant and sank in water. Donders[4] was misled by the fœtal condition of the lungs in a seven-months child and gave it as his opinion that it had died in utero a short time before birth, whereas it had really been born alive, had cried distinctly after its birth, and lived for twelve hours. Many similar cases[5] are recorded, and noticed by Hofmann, Liman, Taylor, Tidy, Ogston, Guy, and other writers on medical jurisprudence. (See case 4.)

When air is not found in any portion of the lungs in such cases it is impossible to determine from the lungs whether the child was born alive or dead.

b. Disease may consolidate the air-cells and prevent the entrance of air, as in œdema, congestion, hepatization, scirrhus, etc. It is very unlikely that both lungs would be affected in every part—some cells would be found inflated if the lungs are carefully examined; moreover, the well-known appearances characteristic of these affections would be easily recognized by the pathologist. In criminal cases, it is always necessary to exclude disease as a possible cause of airlessness. (See cases 6, 7.)

---

[1] Hencke's Zeitschrift, 1837, ii., 422.

[2] Hencke: "Lehrb. d. ger. Med.," 374.

[3] Lancet, 1855, i., 121.

[4] Dublin Med. Press, November 22d, 1865, p. 456.

[5] See Lancet, 1872, i., 227; Guy's Hosp. Reports, 1837, ii., 346, 355; Annales d'Hyg., 1878, ii., 489; Lond. Med. Gaz., xxxix., 283.

2. LUNGS WHICH HAVE NOT BREATHED MAY FLOAT.—*a. Artificial inflation and respiration* may produce appearances similar to those of natural respiration. Practically in criminal cases, little weight need be attached to this objection, for artificial inflation would most likely be practised by the medical attendant or the mother to save the child's life. Presumably any person attempting to destroy a new-born child would seek to prevent respiration rather than to establish it, to maintain the lungs in their fœtal state rather than to inflate them with air, to create a presumption of dead-birth rather than live-birth.

While it is easy enough to inflate a lung artificially outside the body, it is by no means easy to do so *in situ*, especially if the person attempting inflation is unskilled and ignorant of the anatomy of the parts. Many medical jurists deny the possibility of perfect inflation by mouth or tube.

It is proved by experiment that in insufflation by the mouth-to-mouth method, or by a canula passed into the child's mouth, more air is forced into the stomach and intestines than into the lungs. The stomach and intestines of dead-born children are airless and sink in water, and can therefore be easily distinguished from the bloated, distended condition which follows artificial inflation.

Inflated lungs contain air, but they are comparatively bloodless, for the establishment of the pulmonary circulation is coincident with respiration.

Kotelewsky[1] claims that the injection of the interalveolar vessels taken along with rose-colored marbling of the lungs is characteristic of respiration, and that absence of these appearances proves that any air which is present has been introduced artificially. This view is not correct, because there is more or less blood in the interalveolar and interacinous vessels, even in children born asphyxiated, and if air be blown in forcibly there will be more or less rose-colored marbling. The more blood there is in the vessels the more perfect the marbling. Emphysema is apt to occur after inflation either on the surface of the lungs or interstitially from over-distention and rupture

[1] Wien. med. Blätter, 1882, No. 18.

of the air-cells by the excessive force employed. Yet it must be borne in mind that interstitial emphysema might be due to other causes. It is much easier to squeeze the air out of an artificially inflated lung than out of one which has been distended by natural respiration. It is easy to distinguish an inflated lung from one that has been completely expanded by respiration; but it is far more difficult to make a diagnosis if the distention has only been partial.

Air may be forced into the lungs of still-born or dead-born children by the violent use of Schultze's or Pacini's[1] method of performing artificial respiration. This has been the subject of much controversy on the continent, especially in Germany. Hofmann[2] doubts whether air gets into the lungs after Schultze's swinging as easily as affirmed by Runge and others.[3] But so many cases have been reported, that there can no longer be any doubt that air may be forced into the lungs by the violent or prolonged use of Schultze's method. (See cases 23–28.)

Besides forcing air into the lungs, Schultze's method may cause serious internal injuries, such as rupture of liver, spleen, heart, or kidneys, and may even fracture the ribs or other bones. Runge[4] cites a case in which a child twelve days old died of diarrhœa and vomiting. He compared the lungs with those taken from a dead-born child which had been subjected to Schultze's swinging. The lungs of both children gave the same appearance in respect of color, distention with air, marbling, bloody froth in smaller bronchi, etc., so that no one could tell from their appearance which were the lungs of the dead-born child. If the child is premature and a small number of swings given, the air may not enter the lungs, or may do so to a very slight degree. But even if air does enter the lungs as the result of artificial respiration, there is never the uniform distention which occurs after natural respiration. In one case mentioned by Pellacani, 163 respiratory movements were made and the lungs were only incompletely filled with air.

---

[1] Virchow's Jahrb., 1889, 1.

[2] See Wien. med. Blätter, 1884, No. 34; Wien. med. Wochensch., 1885, No. 10.

[3] Wien. med. Blätter, 1884, No. 29; *ib.*, 1885, No. 1; *ib.*, 1885, No. 8; Wien. med. Wochensch., 1885, No. 8; Deutsch. med. Zeitung, 1886, No. 1; Vierteljahrsch. f. ger. Med., xlii., 1; *ib.*, xliii., 253; *ib.*, N. F., iii., 29.

[4] Eulenberg's Vierteljahrssch., N. F., xlii., 41.

Laborde's method of rhythmic tongue tractions, now used extensively for the resuscitation of still-born children, may force air into the lungs, and cause injuries which have some medicolegal importance.[1]

b. Putrefaction.—The possibility of putrefactive gases being the cause of the lungs floating is only admissible when the body shows elsewhere the signs of advanced decomposition, and when there is undoubted evidence of putrefaction in the lungs.

The lungs *in situ* are slow to decompose, and if the hydrostatic test is carefully used, there should be very little chance of error. Ogston in 52 cases (in some of which the child had been dead for five months) found none where it was difficult to use the hydrotastic test on account of putrefactive gases.

When lungs begin to decompose they change color from imbibition and the conversion of hæmoglobin into methæmoglobin and then into hæmatin. (Fig. 3, Pl. III.) The first blebs appear in the blood of the large vessels, which becomes frothy. Then they are observed singly and in groups in parts of the lung where there is blood-imbibition. Air-bubbles are visible under the pleura, which they presently lift up into larger or smaller blebs. If the larger ones are punctured, the air escapes. In the earlier stages of decomposition, pricking the blebs may cause the lung to sink, but when decomposition is far advanced and the lungs are pulpy, putrefactive blebs may be found in lungs which have breathed, and the lungs may sink when the blebs are punctured.

Putrefaction never causes the uniform distention which is found after natural breathing or inflation. Hofmann mentions a case in which an autopsy was made on a woman who had died of uterine rupture during labor. Putrefaction was far advanced, and in the abdominal cavity was found a child much decomposed. Not only the child's liver, spleen, kidneys, stomach, and intestines floated, but its whole body as well; yet the lungs were fœtal in appearance and sank when placed in water. In selecting a portion of lung for the hydrostatic test where putrefaction has begun, it is well to take it from the centre of the lung and not from the surface.

c. Emphysema has been suggested as an objection to the hydrostatic test. But no case has yet been reported in which emphysema developed spontaneously in fœtal lungs where labor had ended without assistance. But even if emphysema did occur, the air could be dislodged by pressure, and the appearances would not resemble those which follow natural breathing.

---

[1] Knapp: Centralb. f. Gyn., 1896, No. 78.

d. Freezing and alcohol.—In the winter season or in cold climates it is worth remembering that even airless lungs may float when frozen, but they sink after being thawed out. It is also to be noted that lungs which have been lying for some time in alcohol may float, but if they are left in water till the alcohol is extracted they sink. On the other hand, lungs which would float, if allowed to lie in running water for days will sink, but will float again when dried.[1]

It is evident therefore that the hydrostatic test is fairly reliable and enables us to say in most cases whether respiration has taken place or not if the presence of air is demonstrated in the lungs. But what conclusions can we draw if the lungs are found to be airless? In the great majority of cases it may be affirmed that the child was born dead. Exceptional cases may be explained in one of three ways:

(1) The child though alive may not have attempted to breathe.

(2) It may have tried to breathe, but the air was prevented from entering its lungs.

(3) Air may have entered the lungs in small quantity and subsequently disappeared.

(1) Before the 28th to 30th week the fœtus is so immature that, although born alive, it may be unable to breathe from weakness of the respiratory muscles and lack of development of the respiratory centre. If a little older, it may live and breathe superficially for a time and even cry, but does not seem to have power enough to dilate the air-cells; the respiration is bronchial, death occurs within twenty-four hours, and the lungs are found airless.

Sometimes the child is slow in beginning to breathe, opening its eyes and looking around for a minute or two before making a respiratory effort. In such cases a modified placental circulation is generally going on, and CO_2 has not accumulated in sufficient quantity in the blood to excite the respiratory centre, but the heart-beat is usually strong and regular, while in asphyxia it is apt to be weak and irregular; the former is a condition of apnœa, the latter one of asphyxia, and the diagnosis is not difficult.

---

[1] Eberty: Vierteljahrs. f. ger. Med., 1885, xliii., 241.

Badstübner: "Ueber Verschwinden der Luft aus den Lungen Neugeborener. Berliner Dissert.," 1893.

De Arcangelis: Giornale di Medic. legale, 1894, i., p. 22.

Occasionally compression of the brain from extravasation of blood beneath the membranes may retard or prevent respiration. The commonest cause is asphyxia. Presence of life is indicated by the heart-beat and feeble attempts to breathe or move. It is impossible to tell from the appearance of the child whether the case is hopeless, or whether the asphyxia may be overcome by proper treatment; in the most promising cases we sometimes fail, and in apparently desperate ones we sometimes succeed. It is therefore impossible for a medical witness to say in the case of a child which was born alive and died asphyxiated, that it would have lived had proper means been employed to resuscitate it.

(2) The child may have attempted to breathe, but the entrance of air may have been prevented either accidentally or by violence. The membranes may cover the mouth and nose, or foreign matters may enter the respiratory passages during the progress of birth (meconium, mucus, or liquor amnii), or congenital disease or deformity may cause a mechanical obstruction to the entrance of air.

There is usually very little difficulty in diagnosing such cases; but when air has been excluded accidentally or intentionally, the diagnosis is more difficult. The child may lie face downward in a pool of blood or discharges, or it may be born into a bucket or bath of water; its head may be closely enveloped with bedclothes, its face compressed by the mother's thighs, the mouth and nose kept forcibly closed, or its neck constricted by a coil of the umbilical cord, or a garter, handkerchief, string, or other ligature. The constriction may be accidental or applied with criminal intent. In new-born children the heart may beat for some time although respiration is not established, and as long as it beats there is chance of resuscitation. (See cases 8, 11, 18, 19, 20, 29.)

The heart is frequently found beating half an hour after birth, occasionally as long as two hours. New-born animals have lived twenty-eight to thirty-six minutes under water; grown animals would have perished in three minutes. Hofmann has found the heart beating five hours after birth in animals.[1] Maschka describes a case when the heart-beat was detected by auscultation twenty hours after the new-born child had been laid aside as dead; in another, life was not extinct five hours after the child had been buried under a foot of earth. Bardinet's case was alive after being buried for eight hours under ten inches of ground.[2] The cause of such great resisting power in new-born children has not yet been satisfactorily determined, although many explanations have been proposed.

(3) Lungs which have contained air may subsequently lose it. Through the elasticity of the lung-tissue more air may be expelled during expiration than is replaced during the succeeding inspiration. In this way the lung may empty itself more or less completely of its contained air. Prof. Arrigo Tamasia[3] has shown by experiment that a lung left to itself will in no case lose air spontaneously to such an extent as to sink to the bottom when placed in water. Ungar's[4] explanation is that the air is absorbed by the blood circulating in the pulmonary capillaries. Seydel[5] reports a case in which a premature child (about the thirty-second week) was born alive; there was great difficulty in establishing respiration, but it finally breathed well and cried. It was put to the breast and nursed, and then laid in a cradle with its head uncovered; it died in four hours. On section the lungs were found to be nearly airless, and no piece could be got to float. A few bubbles and a little froth were squeezed into the trachea by pressure of the lung. The lungs were dark blue, with smooth surface and numerous dark subpleural ecchymoses.

From these considerations it is evident that live-birth cannot be positively affirmed because the lungs contained air nor dead-birth because they were airless. The post-mortem examination of the lungs gives no signs by which live-birth may be positively affirmed or denied.

---

[1] Wien. Med. Pres., 1878, No. 10.

[2] Schmidt's Jahrb., 1874, p. 9; Med. Centralb., 1880, p. 462.

[3] Riv. Sperim. di fren. e di med. leg., viii., 4 (med. leg.), p. 525, 1883 (Schmidt's Jahrb.). *Cf.* Vierteljahrs. f. ger. Med., xix., 246.

[4] Eulenberg's Vierteljahrssch., N. F., xxxix., 12, 213.

[5] Eulenberg's Vierteljahrssch., 1891, ii., 5.

Changes in the Cord.—Shortly after the cord is ligated and cut, changes begin to take place in the stump. It loses its shiny, polished appearance and becomes dull in color, a line of demarcation forms, it slowly dries, shrivels, and separates in four or five days or more by dry or moist gangrene. Meanwhile the umbilical vessels have become occluded, and the stump is completely healed when the cord drops off, or cicatrizes in a few days. Pulsation of the cord after the child is completely born is a positive sign of life. If the cord is not tied, pulsation usually continues for two or three minutes or even longer if the placenta remains attached to the uterine wall, and a modified placental circulation persists for a time.

When the cord separates by dry gangrene it is said to mummify. This is most apt to occur if the cord is thin and contains but little Wharton's jelly, and if it has been wrapped up and kept dry and warm. The formation of a line of demarcation is a sign of vital reaction signifying that the living is separating the dead and casting if off. A microscopic examination of the tissues of the cord (especially the vessels) may help to determine how long the child has lived. In strong full-term children the cord separates sooner and better than in delicate, premature children.[1] In the Montreal Foundling Hospital, a child died on the seventeenth day from abscess of the sternum, the result of purulent pericarditis. The cord had not yet come away, and there were no signs of inflammation about it.

The umbilical arteries usually begin to contract in twenty-four hours, the vein somewhat later. But variations occur so frequently that little reliance can be placed upon these changes for medico-legal purposes.

Closure of the foramen ovale and obliteration of the ductus arteriosus and ductus venosus are signs of live-birth which have been studied a great deal on the Continent; indeed an abundant literature has sprung up about the "*docimasia circulationis*," as the examination of these fœtal structures is called. But the value of such evidence is only corroborative; patency of all three does not necessarily imply that the child was born dead, nor is the immediate or early closure of any or all of them necessitated by live-birth. Normally they are rarely obliterated before the eighth to tenth day, sometimes not till the sixth to eighth week, and occasionally the foramen ovale never closes. The order of obliteration is not always the same.

---

[1] The condition of the navel is not always a proof of the age of a child. Loviot records a case where the cord did not fall till the seventeenth day. Archiv. de Tocol., xvii., 411.

Changes in the Skin.—The skin of the new-born child is described as passing through certain color-changes which not only denote life but also give some idea of the age. Dark red at first, in an hour or two it becomes light red, darkening again in a couple of days; it often becomes more or less yellow, and in seven or eight days finally settles down into the normal reddish-white color it afterward maintains. Desquamation of the epidermis usually occurs, but does not follow any regular order or last any definite time. Little reliance can be put on these color-changes for medico-legal purposes.

Middle-Ear Test.—In 1868 Wreden stated that the pad of epithelial cells and fœtal jelly, which fills the cavity of the tympanum in the mature fœtus, retrogrades and retracts during the first few hours after birth so that the tympanum contains air. Wreden and Schmaltz[1] consider it of importance medico-legally to determine whether the tympanum and Eustachian tube are airless or not. Presence of air implies respiration, but then more reliable evidence is obtainable elsewhere. Middle-ear changes may appear in a few hours or not for several weeks; their absence is no proof that live-birth has not taken place.

Changes in the Liver.—The liver shrinks after birth and becomes lighter. Bernt of Vienna proposed the loss of liver weight as a test of live-birth. It is not reliable, for there is no means of knowing the weight of the liver before birth, and consequently no means of determining its loss of weight after birth.

Changes in Bladder and Kidneys.—It has been stated that a full bladder signifies dead-birth, an empty bladder live-birth. This test is worthless, for not only may a live child retain its urine for some hours after birth, but the bladder may be mechanically emptied during labor and the child be subsequently born dead.

Uric-acid infarction in the kidneys has been claimed by some German authorities to be a positive proof of life. Vogel says that it is as positive a sign of life as dilatation of the lungs with air. The deposit consists of golden-yellow streaks of crystallized uric acid, most abundant in the papillæ of the kidney, deposited there because sufficient water has not been excreted to wash it away. Engel says that uric-acid crystals are rarely found in the kidneys of children that have breathed for a whole day. This does not correspond with our own observations in this city. In the post-mortem examinations made at the Montreal Foundling Hospital, uric-acid infarctions have been very frequently found in the kidneys of children dying of marasmus, up to the age of four months.

---

[1] Lancet, 1877, ii., 741.

Subsequent observations have failed to substantiate the claims made by the promoters of this test, and it cannot be considered reliable.

Changes in Stomach and Intestines (BRESLAU'S TEST).—The stomach and intestines of the unborn fœtus are as airless as its lungs; but as soon as respiration begins, air enters the stomach and spreads gradually down through the bowels. It is not yet determined whether the first air-bubbles in the stomach are produced by efforts to swallow or by the aspiration of air.

In 1866 Breslau[1] proposed a hydrostatic test for the stomach and intestines similar to that used for the lungs, and claimed that the amount of air contained and the distance to which it penetrated are proportionate to the extent and duration of respiration. His conclusions have been verified in the main by numerous observers.

In the majority of cases, coincident with the first breath of extra-uterine life, air enters the stomach and enables it to float on water. Occasionally it happens that the stomach and intestines do not float though the child has lived and breathed after birth, just as exceptionally the lungs are found airless under similar circumstances.

This test has been found particularly useful where air has been prevented from entering the lungs by foreign bodies or occlusion of the bronchi. When respiration is impeded or imperfect, air enters the stomach in larger quantity and extends farther down into the intestine than when respiration is fully and speedily established.

---

[1] For a full discussion of the explanations offered by Breslau, Kehrer, and Ungar, see Vierteljahrssch. f. ger. Med., xlviii., 234; also Falk in Zeitschrift f. Geb. und Gyn., xiv., Hft. 1.

Besides air, foreign bodies (sand, earth, meconium, liquor amnii, etc.) may be drawn into the stomach by the active swallowing movements which a child makes when it is suffocating. In a new-born child which had been buried, Maschka[1] found earth in the stomach and streaks of it in the intestine.

The objections to this test are that air may get into the stomach and intestine of dead-born children, and that it may disappear from those of live-born children. Winter[2] reports nine cases in which more or less air was found in the stomach (and twice in the intestine) of undoubtedly dead-born children. It must have got there before birth. Air may be forced into the stomach by artificial inflation or by the use of Schultze's method of artificial respiration, provided there is communication between the intrathoracic œsophagus and the outside air. Air may be absorbed or may be forced out of the intestine and stomach by peristaltic action.

The positive results of this test are inferior to those of the hydrostatic lung test when decomposition is well advanced, for putrefaction occurs sooner in the stomach and bowel and advances more rapidly than in the lung, especially if meconium or liquor amnii has been swallowed. Nikitin[3] says that in 100 cases in which this test gave positive results, the lung test was negative in five cases; in two of these cases the child was known to have lived, in the other three it was not known. He had one case in which the child lived five days and at the post-mortem examination the stomach and intestines were found airless. Wendel[4] reports a case where a child lived eleven hours, and the stomach and intestines were found airless.

In order to determine how far air has penetrated into the intestinal tube, the rectum should be ligated before the bowel is removed from the body, and the floating capacity tested piece by piece beginning at the rectum.[5] This test cannot replace the hydrostatic lung test, but it may substantiate and enlarge or even correct the evidence afforded by the older test; it should not therefore be omitted or neglected. It is best to tie the stomach at the pylorus so that stomach and intestines may be removed separately, and it may be more easily determined how far the air penetrated into the bowel.

---

[1] Vierteljahrssch. f. ger. Med., xlv., 242.

[2] *Ibid.*, li., 101.

[3] Vierteljahrssch. f. ger. Med., xlix., 282.

[4] Inaug. Dissert., Dorpat, 1891; "Ein Beitrag zur Lehre vom Kindesmorde."

[5] Körber: "Sectionstechnik für neugeborene Kinder," Dorpat, 1888, p. 83 *et seq.*

An examination of the contents of the stomach sometimes gives important information. Meconium, blood, urine, liquor amnii and other matters may be detected in the stomach as well as the respiratory passages during the post-mortem examination. Their presence indicates that the child was alive at or shortly before its birth, but does not prove live-birth. It is otherwise if the liquid or foreign matter is of such a nature that it could only have been swallowed after birth; then its presence in the stomach is a proof of live-birth. A woman was delivered suddenly while sitting over a bucket of dirty water; though the child's lungs were airless, some of the water was found in the stomach. Although it did not breathe, it must have been born alive, else it could not have swallowed some of the water into which it fell.

The meconium is odorless and of a dirty green color, and is normally found in the large intestine; in order to get into the stomach, it must have escaped into the maternal passages during labor, and then been swallowed during premature attempts at respiration.[1]

Before birth the fœtal stomach contains mucous or albuminous matters; gastric juice does not appear till after respiration. If any foreign matters or foods are found in the stomach, they must have been swallowed, but not necessarily after the complete birth of the child. Starch, sugar, and milk are the commonest foods found in the stomach, with or without an admixture of pavement epithelium from the mouth and passages. Starch is recognized by its microscopical appearances and its reaction with iodine. If a fragment be treated with a few drops of distilled water, and a drop or two of iodine solution added, the characteristic blue color will be developed. The various kinds of starch are easily made out under the microscope, and may be detected in smaller quantities than are ascertainable by chemical tests. Sugar is readily recognized by the ordinary chemical tests. Milk and colostrum are discovered by the microscope; it is not generally possible to distinguish human breast-milk from that of the domestic animals.

---

[1] Viertelj. f. ger. Med., 1863, i., 97, also Med. Times and Gaz., ii., 116.

The positive recognition of meconium may have an important bearing in determining the question of live-birth. Some apparent confusion exists among authors as to the appearance and constituents of meconium. Huber[1] attributes this to the non-recognition of the fact that meconium is found in two distinct forms which may exist separately or together.

(1) *Dark-green*, ropy, richer in mucus and the yellowish-green oval bodies which give it color and are characteristic. (Fig. 30, *a*.)

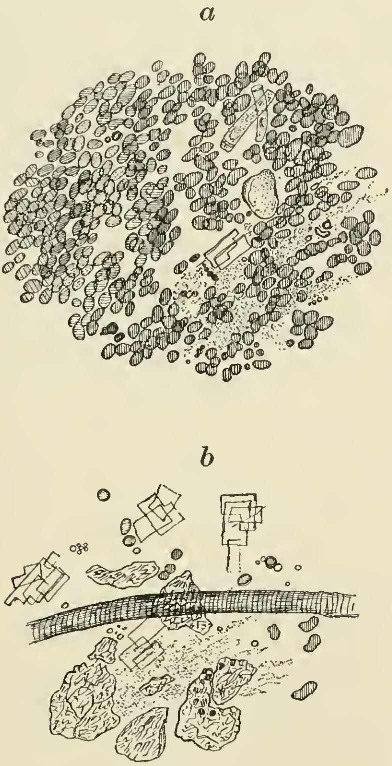


Fig. 30.

(2) *Yellowish-brown*, containing yellowish epidermis cells, numerous cholesterin plates, fatty cells, and lanugo hairs derived from liquor amnii which has been swallowed. (Fig. 30, *b*.)

---

[1] Friedreich's Blätter, xxxv., 24.

Tardieu figures these yellowish bodies ("Étude Médico-légale sur l'Infanticide," 1880, p. 399).

Stains of meconium on the clothing are sometimes important.[1] They are brownish-green, stiffen the fabric, are raised above the surface but do not always penetrate deeply into it. With water they form a greenish solution which is acid and unaffected by boiling. If the stains have been made by fæcal matters, the color, odor, and reaction give evidence as to the age of the child.

Iron-lung Test (ZALESKI'S TEST).[2]—Non-breathing lungs are not functioning and are in the fœtal condition. They contain only sufficient blood for their nourishment and growth; but when respiration begins, a larger quantity of blood is directed to them. As there is more blood in the lungs after respiration than before, and as iron is a constituent of the blood, there must be more iron in lungs which have breathed than in those which are in the fœtal state.

Zaleski claims that it is possible to determine live-birth in doubtful cases by a quantitative analysis of the blood found in the lungs. He directs the lungs to be carefully ligatured and removed, washed and tested by the hydrostatic test. They are then to be dried, weighed, and exposed to an air-bath of 115°–120° C., the dry residue weighed and reduced to ashes, and the amount of iron determined as well as its percentage to the weight of the lung. The following table shows his results:

	Dead-born. Per cent.	Live-born. Per cent.	For live-born children or adults. Per cent.
Dry matter	13.22	15.87	16.86
Proportion of Fe to fresh lung.	0.011—	0.0188—	0.0217
Proportion of Fe to dry lung .	0.0828—	0.1182—	0.1266

Zaleski's results have been questioned by Jolin and Key-Aberg of Stockholm.[3] They examined eighteen cases of children who died before, during, immediately after, and some time after birth, and found that no such constant relation exists as stated by Zaleski.

The Bacteriological Appearances of Putrefaction.—This is the most recent test which has been suggested for distinguishing a child which was born alive and breathed from one which was born dead. Dr. Malvoz of Liège has investigated this subject, and his observations were communicated to the Academy of Medicine of Belgium.[1] It has been frequently observed that, other things being equal, putrefaction runs a different course in a new-born child which has lived and breathed than in a fœtus which has perished before, during, or immediately after birth without breathing. The micro-organisms are different, attack the organism in a different way, and produce different results. In dead-born children putrefaction begins in those parts of the body which are in contact with the outside air, and is effected by means of the ordinary bacilli found in animal decomposition (bacillus fluorescens, proteus, etc.). In children which have lived and breathed, air enters the stomach and intestines, and putrefaction begins in the intestines; the active agents belong to the family of the coli-bacilli. If these observations are confirmed, a bacteriological examination will afford valuable information which may be decisive in some cases of infanticide. It must be borne in mind also that the putrefactive process is influenced markedly by the environment of the body. It may have been exposed for a time or continuously to the air (in the open or in a confined space), or it may have been under water, or in the ground, or surrounded with the filth of a privy or cess-pit.

---

[1] Fried. Blät. f. ger. Med., 1884, 24, 142.

[2] Vierteljahrssch. f. ger. Med., xlviii., 68.

[3] Vierteljahrssch., li. 343.

II. IF THE CHILD WAS BORN ALIVE, HOW LONG DID IT LIVE AFTER BIRTH?

In some countries the law holds the destruction of the child immediately or shortly after birth to be a less serious crime than its cold-blooded murder hours or days afterward. Pain, excitement, and mental anguish are considered as mitigating circumstances, especially in the case of illegitimate children. Such excitement may last for hours or even much longer in exceptional cases. It is not safe to set any time limit in such a matter; each case must be judged upon its own merits. A medical expert should be very careful how he testifies to a mother's responsibility or irresponsibility for the destruction of her new-born child, unless he has personally seen her behavior at and after her confinement.

---

[1] "Recherches bactériologiques sur la Putréfaction des Nouveau-nés et leurs Applications médico-légales;" Académie de Médecine de Belgique; Séances des 28 Octobre et 25 Novembre, 1893; La Semaine Médicale, 6 Dec., 1893.

In order to estimate the length of time a child has survived its birth, attention must be paid both to external and internal appearances.

Externally, the fouling of the body with blood and maternal discharges would probably indicate that the child had not been washed; but such appearances would be absent if the child had been born into water or put into water immediately after its birth.

Much more weight can be attached to the presence of vernix caseosa in the axilla, inguinal region, or folds of the neck. The vernix is not very easy to remove and may remain a day or more; if present it denotes with tolerable certainty that the child is new-born. Its absence does not prove that the child was not new-born, for some children are born with little or no vernix.

The color of the skin and the extent of exfoliation may give some assistance in forming an opinion, but too much stress must not be laid upon these appearances.

The appearance of the caput succedaneum gives valuable information when it is present; but its absence means nothing, for labor may have been rapid and easy and no caput may have formed.

The most reliable information is obtained from the navel and stump of the cord. The child is new-born if the cord and placenta are still attached, or if the cord has been divided and the portion attached to the child looks fresh and unchanged. If the child lives, the cord soon shrinks, shrivels, and mummifies, the drying process starting at the free end of the cord. From the second day the line of demarcation is usually apparent and the dead gradually separates from the living, the vessels being the last to give way. After the cord falls there is contraction of the ring, and retraction of the arteries. It must not be forgotten that in the dead body of a new-born child decomposition goes on rapidly in the cord, and that if exposed to the open air or a dry atmosphere it dries as quickly as in life. The time at which the cord separates naturally, varies from two days to two weeks or more. In Loviot's[1] case, the cord did not fall till the seventeenth day. The condition of the navel therefore is not always a proof of the child's age. A cord which has already hardened may soften, swell, and become fresh-looking if the body is wrapped in wet clothes or is lying in water. The cord may be torn away from the child's body accidentally during birth, or purposely afterward. In the fresh state, the appearance of the umbilical wound, the condition of the vessels, and the presence of shreds of amnion would make the diagnosis easy; but if decomposition be far advanced, no positive conclusions can be drawn. From the appearance of the navel and cord in the fresh state, it is generally possible to say that the child was less or more than two days old when it died; but it is difficult to say whether the child died immediately after birth, or to fix the time of its death within the two days.

---

[1] Archives de Tocologie, xvii., 411.

INTERNALLY, the appearance of the lungs may give some evidence respecting the length of time the child has lived. A condition of atelectasis is generally presumptive of a relatively short life. Yet it must be remembered that one or two good breaths may suffice to send air into all parts of the lungs, and on the other hand that marked atelectasis may exist in children which have lived for several days or weeks.

The condition of the stomach and intestines may give important information. If air has entered the stomach and penetrated deeply into the intestinal tract, and if artificial inflation and putrefaction can be excluded, it is safe to conclude that the child did not die immediately after its birth. The presence of meconium in the large intestine generally means death very soon after birth; the presence of food shows that it lived long enough to be fed. On the Continent, much attention has been paid to the decomposition bacteria[1] and to insects and their larvæ found in graves (Gräberfauna, Leichenfauna) as a means of determining the time of death.[2]

Some authors have laid stress upon the size of the ossification centres in the lower epiphysis of the femur and the head of the humerus, but no positive conclusions can be drawn from them respecting the age of the child. If the child is congenitally feeble and is not properly nourished after its birth, it may not develop, and ossification may not advance. Dr. Johnston of Montreal reports the case of a child examined by him at a coroner's inquest, in which there was no point of ossification in the femoral epiphysis, though the child was six weeks old. It died of broncho-pneumonia.

---

[1] Flügge: "Die Mikroorganismen," iii. Aufl., 1896, Bd. i., p. 254, Bd. ii., p. 270.
Hoffa: Münch. med. Woch., 1891, No. 14.
Tonin: Virch. Jahrb., 1896.
Lösener: Wien. klin. Wochens., 1896, p. 255.
Löw: Zeitschr. f. Heilk., 1900, xxi.

[2] Megnin, Reinhard, Jovanovitsch, etc.: Virch. Jahrb., 1883, i., 517; *ibid.*, 1888, i., 467; *ibid.*, 1894, i., 477.
Mingaud: Ann. d'hyg., 1896, xxxv., 424.
Nietzabitowski: Vierteljahrs. f. ger. Med., 1902, H.1, p. 44.

It will thus be seen that we have no certain means of determining how long a child has lived after its birth; but an approximate idea may generally be gained by a careful consideration of all the external and internal appearances.

III. WAS DEATH DUE TO NATURAL CAUSES OR TO VIOLENCE?

Death may occur during or after birth, and in either case it may be due to natural or unnatural causes. Since many children die either in the process of birth or afterward from natural causes, the law presumes a natural cause for death till the contrary is proven. The onus of proof is therefore thrown upon the prosecution.

It has been estimated that still-birth occurs once in every eighteen to twenty cases among legitimate children, once in every eight or ten among illegitimate and immature children; it is in these latter cases that charges of infanticide are most frequently brought. Still-births occur oftener in primiparæ than multiparæ, oftener among male children than female. Infanticide is generally in primiparæ. A child may have been alive during its birth or when born and may die afterward from natural causes. It may have breathed during or after birth and yet die afterward from natural causes.

Natural Causes—Causes Other than Violence.

If the child was dead-born, the cause was most likely natural. If it was born alive and survived for a time, and there were no marks of violence on the body and no poison in the stomach, the cause was probably natural. Nevertheless it may have been destroyed intentionally by exposure, neglect, or omission, or by closure of the mouth and nose to prevent the establishment of respiration.

Though the medical evidence may be unable to establish the fact of criminal neglect or interference, it may be able to show whether the explanations given by the accused as to the mode of death are consistent with the facts, and whether her story is true or false. Again, even if there are marks of violence on a child found dead, they may not have been the cause of death, or they may have been produced accidentally or after death. The following questions may arise in such a case:

(1) Might the marks of violence have been produced by the mother while trying to deliver herself?

(2) Might they have occurred accidentally or unavoidably in the course of an unexpected confinement?

(3) Are they so situated and of such a nature as to indicate intentional and consequently criminal violence?

(4) Might they be due to some malformation?

(5) If the body was exhumed might they have been inflicted during exhumation?

Protracted labor is one of the commonest causes of fœtal death. If the uterine contractions are strong and without intermission, a sufficient quantity of maternal blood may not enter the placenta to maintain the child's life; or the placenta may be partially separated by uterine action and thereby disabled; or the cord may be compressed and the fœtal circulation thereby embarrassed. When the labor is difficult and prolonged, the caput succedaneum is usually large, and the head moulded into the shape characteristic of the presentation and position. The child's death is more apt to occur from such causes if the mother's pelvis is deformed or the soft parts contracted and unyielding, or if the child is very large or deformed, or the cranial bones much ossified. Yet death may occur from natural causes though the fœtus and maternal passages are apparently normal. In such cases the cerebral vessels may be found congested, or an extravasation of blood beneath the meninges. Dr. Wyatt Johnston has pointed out that cerebral hemorrhages may be found post mortem in a macerated fœtus as well as in one still-born. He has also noticed that these blood-clots usually remain firm and persist after the surrounding cerebral tissue is far advanced in decomposition.

Debility.—Immaturity is a common cause of fœtal death during or shortly after birth. The more immature the child the less probability is there of live-birth or the continuance of life after birth. Atelectasis is common in immature children. Though born alive, they may not have sufficient vitality to start the respiratory process without help, and it sometimes requires long and persistent work to establish respiration. If such help is not given the child soon dies, or it may breathe feebly for a few hours or days and finally perish. The immaturity of the child and its inability to breathe properly, are quite evident in such cases. If it is mature and well-developed, and the post-mortem shows that the lungs have been well expanded, the plea of congenital debility would not hold as a cause of death. Holowko[1] records the case of a child born alive in the twenty-seventh week of pregnancy; it measured 37 cm., and weighed 1,300 grammes. Hubbard[2] reports the birth of a very small living child; it was 10 inches long, weighed 18 ounces, the circumference of its head was 8 inches; it lived eight hours. Ahlfeld reports cases of children born at the twenty-seventh and twenty-ninth week which lived. D'Outrepont's case, born at the twenty-fifth week, lived.

When a premature child lives, breathes, and dies in a little while, the question may arise whether death was due to immaturity and weakness, or to difficulties during birth, or to suffocation. The details of such a case are published by Dr. Wollner[3] and the various points fully discussed.

Congenital malformations anywhere or of any vital organ, malformations of blood-vessels, congenital absence or imperfection of any vital organ, imperforate anus or urethra, malformations of the pharynx, œsophagus, or stomach, an enlarged thyroid causing suffocation from pressure, fixation of the epiglottis so as to prevent the entrance of air to the lungs, etc., may cause death.

Monsters usually have feeble vitality and soon perish; but it is illegal to destroy a monster or hasten its death. The experience of medical jurists and obstetricians proves that in many instances the possibilty of independent life is not necessarily destroyed by congenital head monstrosity (micro-, meso-, and hydro-cephalic). A peasant-woman bore a child at full term without assistance. A peculiar deformity of the head was noticed. The child showed signs of life, moved its limbs, and made sucking movements with its mouth. It died in ten minutes after birth. It was found to be an anencephalic monster; the bones of the cranial vault were completely absent, the base of the skull was raised upward and covered with a thin reddish-white pia-mater, the spinal axis was intact. The lungs were airless but moderately full of blood.[1] Fritsch[2] publishes a case in which after perforation, excerebration, and extraction, the child lived for an hour and a half, breathing superficially. The post-mortem showed the lungs to be airless.

---

[1] Centralb. f. Gyn., 1890, 235.

[2] New York Med. Journal, 1890, 491.

[3] Friedreich's Blätter f. ger. Med., xxxv., 111.

Monsters do not necessarily die immediately after birth. Taylor reports two cases: one was a child with two heads; the other was a hemicephalus which was born alive and destroyed by a woman attendant. In Braun's clinic, a hemicephalus lived seven days. Another case of marked microcephalus with arrested development of the cerebrum and an anterior double encephalocele, which could scarcely have been called viable in the ordinary sense of the term, was born alive and died from suffocation in a privy.[3]

Disease may destroy the child's life in utero or render it incapable of living after birth. High fever in the mother, as in the zymotic diseases, is rapidly fatal to the fœtus. Syphilis, cancer, albuminuria, phthisis, and other constitutional disorders are slower in their action but equally fatal. Disease in the fœtus, such as hepatization of the lung, fœtal pneumonia, atelectasis, pulmonary apoplexy, collapse of the lung from pleuritic effusion, apoplexy, softening of brain and cord, sepsis, erysipelas, rickets, fatty degeneration of the heart, spasm of the laryngeal or respiratory muscles, may destroy life. There should be no difficulty in recognizing such gross pathological conditions.

Hemorrhage may occur from the cord, stomach, genitals,[4] rectum; it is most apt to appeaar in the children of *bleeders*, on account of the imperfect coagulability of the blood. In such cases bleeding is apt to recur from time to time till death ensues.

---

[1] Vierteljahrsschrift, 1891, ii., 190.

[2] Centralb f. Gyn., 1891, No 9, 176.

[3] Hofmann's "Lehrb. d. ger. Med.," 9th ed., p. 835.

[4] Cullingworth collected 32 cases. See Liverpool and Manchester Med. and Surg. Reports, 1876.

The free end of the umbilical cord is the commonest site of hemorrhage in new-born children. The cord may not have been tied after being cut or torn, or it may have been imperfectly or improperly tied, or the ligature may have slipped or been removed purposely, or the ligature may have stretched or the cord shrunk. The sooner the cord is cut after birth and the nearer to the abdomen, the greater will be the probability of hemorrhage. A cord that is cut with a sharp knife is more likely to bleed than one cut with a dull knife or scissors, or one that has been torn or ruptured. The ligature is less likely to hold securely and constrict the vessels if the cord is bulky and contains much Wharton's jelly, than if it is thin and small.

If respiration has been well established, dangerous hemorrhage is not apt to occur; yet fatal cases have been recorded, two having come under my own observation. Hemorrhage may occur without interfering with respiration; and if respiration is absent, feeble, or arrested from any cause, the probability of hemorrhage will be greater. There may be fatal bleeding from the stump after separation of the cord, especially in cases of hæmophilia.[1] Accidental rupture of the cord may be followed by hemorrhage in exceptional cases.

There has been considerable controversy respecting spontaneous ruptures of the cord. Most observers agree that it may snap if the woman is delivered while standing or sitting, so that the child's weight jerks and strains the cord. Pfannkuch's observations show that if a sudden jerk be given to a cord, a weight of 500–700 grammes will suffice to break it, but that 2,000–3,000 grammes may be gradually loaded upon it before it gives way. Spaeth has found a fresh cord sustain a weight of eleven pounds. The rupture of the liver, so often found when the cord has been intentionally torn, is caused by the forcible strain put on the child's abdomen during the process. Koch[2] reports the case of a IVpara, æt. 34, who was delivered of a child in the street; the cord was not divided and the amniotic sheath remained intact, but the continuity of the vessels was broken near both ends of the cord. On the third day there was hemorrhage about the navel, and the child died next day.

Lamare[3] has gone thoroughly over the literature of this subject, tabulating and analyzing eighty-nine cases; he concludes that spontaneous rupture seldom occurs when the woman is lying down.

---

[1] Vierteljahrssch. f. ger. Med., 1873, i., 385; Med. Times and Gazette, 1854, i., 287.

[2] Archiv f. Gyn., xxix., 282.

[3] Thèse de Paris, 1888, "De la Ténacité et de la Rupture du Cordon umbilical."

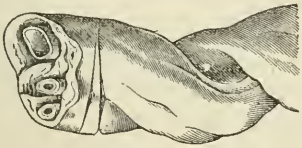


FIG. 31.—Umbilical Cord Cut with a Sharp Pair of Scissors, Showing Openings of the Vein and Two Arteries. A little lower down are two transverse superficial incisions with sharp edges. (Hofmann.)

Cords vary greatly in resisting power: the living cord (warm, injected) is less resistant than the dead cord, and tears with a steady weight of 2,000–3,000 grammes, or 1,000–2,000 grammes if there is a fall or jerk. Short cords are not more liable to tear than moderate-sized ones, nor does thickness seem to have much effect. Spirals and vessel anomalies make weak points in the cord. A single application of force may tear the cord in several places. Contractions of the uterus and the abdominal muscles are occasionally sufficient to rupture the cord; so also may the movements of the child in or out of the uterus.

The point of spontaneous rupture is oftener at the fœtal than the placental end. Hemorrhage from the ruptured and untied end is exceptional. When the mother is delivered in the standing position, and the cord ruptures, the child may receive fatal injury by falling on its head. Briand and Chaudé say that spontaneous ruptures occur only at either end of the cord, but not in the middle. Trachet denies this on the evidence of a case in which the cord tore spontanously in the middle.[1] Westphalen[2] has recently reported two remarkable cases of injury to the umbilical vessels during labor, in one of which the umbilical artery was ruptured before the discharge of the liquor amnii, and the child bled to death.

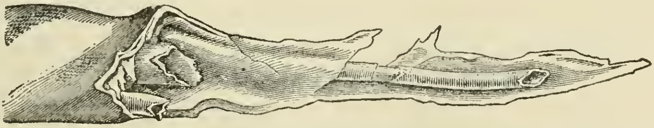


FIG. 32.—Umbilical Cord Torn Asunder during Precipitate Birth, while the Mother was Standing up and Dressing Herself. (Hofmann.)

---

[1] Archives de Tocologie, xv., 611.

[2] Archiv f. Gyn., 1894, xlv., 94.

Rupture of the cord may exceptionally occur when the woman is lying in bed in the usual position, and when traumatism and external manipulations can be excluded. Maygrier[1] reports five cases. Hamill[2] reports a case where death of the fœtus resulted from rupture of a large cyst of the umbilical vein.

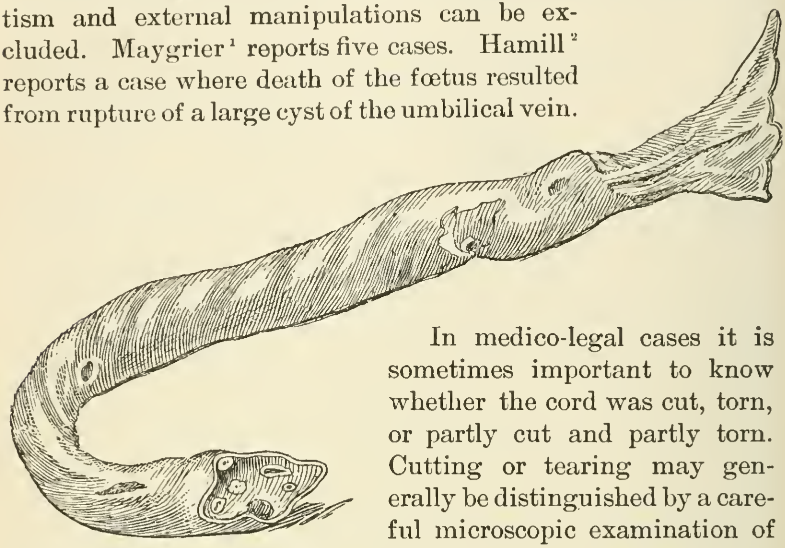


FIG. 33.—Umbilical Cord, Cut at One End, Torn at the Other. (Lesser.)

In medico-legal cases it is sometimes important to know whether the cord was cut, torn, or partly cut and partly torn. Cutting or tearing may generally be distinguished by a careful microscopic examination of the free end. If the cord is dry and hard, the end should be soaked in cold water for eight or ten hours, and then the examination can generally be made satisfactorily. In cases of doubt the cord should be preserved dry on a glass plate or clean white paper; it can be soaked and examined months afterward if necessary. Sections can be made and the relations of the arteries and vein and the degree of decomposition accurately determined.[3]

It is doubtful whether any reliable case is recorded of a cord partially cut and partially torn. Such a condition might be possible if the mother tried to cut it with a dull knife, and impatient at the delay finally tore it asunder; or if she was delivered in the standing or sitting position, and the weight of the child tore through the partially severed cord. A curious case is reported by Koch.[4] A primipara, æt. 25, said that she was sitting in a privy when the child was suddenly expelled; it was dead when taken out of the privy. Question—Had the cord been cut with a knife or scissors, or torn by the weight of the child? There was a difference of opinion among the medical witnesses, but it was finally decided that the cord had been torn. It was interesting to note in this case that several other injuries had been done to the cord by the fall, a possibility which is not mentioned in the text-books. Winckel and Koch have since confirmed this by actual experience. Koch got five injuries in one cord by a jerk from a falling weight without completely tearing it through.

---

[1] Progrès Médical, 1888, 2, 5; compare also Staes, Thèse de Lille, 1888, "Sur la Rupture spontanée du Cordon umbilical;" and Centralb. f. Gyn., 1889, 116.

[2] New York Med. Jour., 1888, 635.

[3] Friedreich's Blätter, xxxv., 391.

[4] Archiv f. Gyn., xxix., 282.

It is not always easy or possible to say whether a cord has been cut or torn. Gioia[1] reports a case where the cord was torn during a forceps delivery; the edges were smooth and indistinguishable from those of a cord cut with a knife. In such cases much depends upon whether the cutting was done with a sharp or blunt instrument; the jagged wound left by the ordinary dull household scissors might be hard to distinguish from a tear.

If the child dies from hemorrhage there is generally blanching of the body and an anæmic condition of the viscera. If wounds exist in other parts of the body, it is well to remember that fatal hemorrhage may have taken place from one of them and not from the cord. It is also possible to fall into error in attributing death to hemorrhage from the cord if the child has been dead for some time, for the anæmic appearance may be due to evaporation of the blood. Finally it is well to make sure that the cord was cut or torn shortly after birth, and not some time subsequently. Tidy[2] mentions a case where the body of a new-born child was taken from a river in which it had been floating for a fortnight, the placenta and cord remaining attached to the body. In removing it from the water the cord gave way and the placenta with part of the cord was carried away by the stream. A medical witness, seeing the ruptured cord and no marks of violence on the body, concluded that the cord had been torn by the woman at the birth of her child, and that it had died from hemorrhage.

Death of the Mother in the Act of Delivery.—How long may a child live in utero after its mother's death? This question has been very fully discussed by Dr. Harris[3] of Philadelphia, and a number of curious cases collected. Much depends upon the cause of the mother's death; if slow, as from hemorrhage, the chance of saving the child is small; if sudden, as from accident, the mother being in good health, the child may live an hour or two after its mother's death, but not longer. Gazerky[1] collected the reports of 379 Cæsarean sections after the mother's death; 37 children showed signs of life and 34 were delivered alive, 5 of whom lived. He refers to Breslau's experiments upon animals and the conclusions drawn therefrom, which are as follows:

---

[1] Gazz. degli Ospedali, 1819, No. 65.

[2] Annales d'Hyg., 1873, ii., 443.

[3] Amer. Journ. of Med. Sciences, lxxviii., 389.

1. The fœtus may undoubtedly survive the sudden death of the mother.

2. If extracted within six minutes of the mother's death, it may be reasonably expected to be born alive.

3. If extraction is delayed six to ten minutes, the child may be born alive, but will probably be asphyxiated.

4. If delayed ten to twenty-six minutes, it is certain to be deeply asphyxiated, even if born alive.

5. Frequently children are more or less asphyxiated or already dead in one minute after the mother's death.

6. The cause of the mother's death has an influence upon the length of time the child may survive.

7. The shorter the time between the application of the cause of death and the stoppage of the heart, the longer will the child survive in utero; death by quick-acting poison is the most favorable for the survival of the child.

8. An immature fœtus survives as long as one at term.

9. Whatever may be the cause of the mother's death, the fœtus always dies of suffocation.

When mother and child both die shortly after the conclusion of labor it is sometimes important to know which survived the other. The medical witness may be asked for an opinion upon this point; but it may be difficult or impossible to arrive at a positive conclusion.

Prolapse of the Cord.—More than 50 per cent of the children are born dead, the circulation being arrested by the pressure upon the cord during the process of birth. Death is from asphyxia. Scanzoni collected 743 cases of prolapsed cord, and in 408 the child was born dead, nearly 55 per cent. Kleinwächter[1] makes the proportion 56.52 per cent.

---

[1] Inaug. Diss., St. Petersburg, 1878; see Centralb. f. Gyn., 1879, 36.

Traction upon an abnormally short cord or one shortened by being coiled about the child's neck or body may cause death in a similar way and be therefore unavoidable. Hohl found 18 fatal cases out of 181; Mayer reports 18 fatal cases out of 685 in Nägele's clinic.[2] Sclafer had a case in which the cord was only 10 mm. long, and Stute[3] reports one where the cord was entirely wanting. The tightening of the coils about the neck may leave marks similar to those caused by soft ligatures applied for criminal purposes; they are broad and never excoriated, and not to be confounded with markings from folds of the skin or ridges in the fat of the neck, especially in winter.[4]

Davis[5] reports a case where the child was born alive and heard to cry, but was subsequently strangled accidentally by the mother, who moved her body away from the child to keep from injuring it. The cord happened to be coiled around the child's neck, and the mother's movement tightened it and strangled the child. In cases where such a plea is set up in defence, the neck should be carefully examined for marks of constriction and the length of the cord ascertained if possible.

Loops or knots of the cord may be tightened either by the child's movements before labor begins or by the expulsive efforts of labor; in the latter event there may be marks of strangulation post mortem although the child was not born alive.

Spasmodic contraction of the uterus around the neck or body of the child may produce suffocation; a similar result may follow compression of the cord in breech, version, or forceps cases, in cases where there is delay or great difficulty in delivery,[6] or where the membranes envelop the face and mechanically prevent respiration.

In any of these cases, premature efforts to breathe may be excited,[7] and mucus, blood, liquor amnii, or meconium aspirated into the respiratory passages just as water is aspirated in death by drowning. The foreign bodies may be recognized with the naked eye, but it is always well to use a lens. A microscopic examination often reveals the presence of epithelial scales, fat globules or crystals, woolly hairs, etc. Ecchymoses are often found in the heart and lungs. It may be said that similar appearances would be present if the child was suffocated after birth by aspirating similar matters; but then air would be drawn into the lungs and the signs of live-birth would be present. The history of the case, the testimony of the professional attendant who would probably be summoned in case of difficulty or danger, and the unmistakable marks of injury or violence, should make the diagnosis of such cases easy. The mortality is much greater in concealed cases, on account of the absence of skilled assistance.

---

[1] Prag. Viertelj., 1870, iii., 84.

[2] Hofmann: "Lehrb. d. ger. Med.," 9th ed., p. 822.

[3] Monats. f. Geb., 1856, vii., 1.

[4] Vierteljahrssch. f. ger. Med., 1873, ii., 219, 224.

[5] Brit. Med. Journ., 1882, ii., 1069.

[6] The head may be so compressed during a difficult labor where there is disproportion between the head and the passage through which it must be forced, that the brain is injured or effusion of blood may take place, which proves fatal either immediately or in a few days.

[7] For numerous references to the literature of death from premature efforts at respiration, see Hofmann's "Lehrb. der ger. Med.," 9th ed., p. 823, note at foot of page.

Violent Causes of Death.

In most cases of infanticide there are marks of external violence such as wounds, bruises, fractures, burns, marks of strangulation, etc. These will indicate the way in which the post-mortem should be conducted to ascertain whether there are internal injuries corresponding with the external. Sometimes there can be no doubt of the wilfulness of the violence—it is too extensive and severe to have been accidental; at other times it may be impossible for the medical evidence to distinguish between wilful and accidental.

In order to secure conviction, the prosecution must clearly prove that fatal violence was purposely inflicted upon a child which was legally alive. The child may die subsequently from the effect of injuries inflicted at the time of birth; upon the presence or absence of intent hinges the legal distinction between murder and manslaughter in its different degrees. The medical witness has nothing to do with such distinctions except in so far as the site or degree of violence bears upon the wilfulness or otherwise with which the injury was inflicted.

A question of professional responsibility sometimes arises in this connection. Medical men have been accused of culpable ignorance or carelessness, or malpraxis, when the death of mother or child has followed some operative interference. In a case of difficult forceps delivery one of the cranial bones was fractured and the child died immediately after its birth; the attendant was tried and convicted of manslaughter. It will probably be alleged in prosecutions of this kind that unnecessary violence was used and that the injuries inflicted were due to the ignorance or unskilfulness of the attendant, or that the case was manifestly unsuitable for instrumental interference, and the operation should not have been performed. Proof of gross ignorance and incompetence would be necessary for conviction. It is very difficult to decide from a post-mortem examination that an operation was unskilfully performed or that the operator was ignorant and incompetent. It is also much easier to tell, after an operation is over, whether or not it was the best which could have been done under the particular circumstances. Positive opinions should therefore be given with great caution. Physicians should protect themselves against subsequent annoyance when called to a difficult operative case which has been under the charge of others. It is always well to ascertain whether any injuries already exist in the genital tract before undertaking further operative measures.[1]

Neglect or Omission.—A child may be born alive and die from neglect to tie the cord properly; it may be suffocated by the bed-clothes or the blood and discharges of the mother, or by pressure of her thighs. When the mother is suddenly seized with labor pains, and the child is born while she is standing or sitting over a closet or privy, the child may drop upon the floor and fracture its skull, or may drop into the closet or privy and suffocate before help comes.

Such an accident is very unlikely to happen in a woman's first confinement, and is therefore not very likely to be admitted as a satisfactory defence in the case of a primipara. The law presumes that a married woman or one who has borne children should know what ought to be done for a new-born child; yet she may be incompetent to attend to the child herself at the time of her confinement, having been overcome by pain, faintness, hemorrhage, or excitement. She should make her condition known when she feels labor pains coming on, and should seek help when about to be confined. The defence which is usually advanced is that she was surprised by the sudden and violent onset of labor, and so overcome by faintness that she could not attend to the child. Such a plea would not hold good unless she could prove that labor was really precipitate or that she had tried to get help but could not, or that the child was born before assistance arrived. The mother has been severely punished for concealment and culpable neglect,[1] but conviction is always difficult, since there must be positive proof from her own admission or from medical evidence that the child was born alive.

---

[1] In a case sent into the Montreal Maternity Hospital, in which four physicians had failed to deliver by means of forceps, examination showed that frightful damage had been done to the uterus. At the autopsy it was found that one blade of the forceps had been forced completely through the muscular wall. If a careful examination had not been made before delivery in hospital, it would have been impossible to fix the responsibility for the injuries.

With regard to negligence, the law generally holds that if a woman has failed to take ordinary precaution to save her child, she is guilty of criminal negligence.—"*Qui tacet, consentire videtur.*"

The possibility of a woman's fainting and losing consciousness during the birth of her child is now abundantly proved. It is more apt to occur when an attempt is being made to conceal the birth, than when labor is going along in the ordinary way. There is no positive sign by which we can judge afterward whether a woman has fainted during delivery or not; we can only judge of the truthfulness of her story by a careful examination of all the circumstances.[2]

Suffocation is the commonest form of violence because it is the easiest. Tardieu says that out of 132 new-born children which he examined, in 72 there was clear evidence of death by suffocation. The mouth and nose may be obstructed by the body or clothing of the mother, or foreign substances which prevent the entrance of air to the lungs. The child may be placed face downward on a soft pillow or feather-bed and allowed to suffocate, or a pillow may be held over its face. Respiration may be prevented by keeping the mouth and nostrils forcibly closed, or it may be arrested if it has been established. Or the child may be received in water or other fluid, or it may be born in a closet or privy vault and its mouth and trachea be choked with fecal matter, water, ashes, or dirt. Feathers, wool, mud, clay, sponge, handkerchiefs, hay, and other such substances have been forced into the new-born child's mouth to suffocate it; or it may be prematurely buried, or its body forced into a small box or trunk.[1] An infant of five months died suddenly in Haute-Savoie. Eight dark gray bodies were found in the stomach, which proved to be pieces of sponge given to the child with criminal intent.[2] (See cases 17, 18, 19, 20.)

---

[1] Taylor's "Med. Jurisp.," Am. ed., 1892, p. 569.

[2] For a full review of this subject, see Freyer's "Ohnmacht bei der Geburt," Berlin, 1887. A large number of cases are analyzed and tabulated in the appendix.

The real difficulty in many of these cases is to determine whether death was accidental or not. A careful examination should be made of the mouth and air-passages both inside and out, to ascertain whether violence had been employed, and whether the foreign matters had been forcibly introduced or accidentally aspirated. There should be no marks of violence, or at least not such as would indicate attempts upon the child's life, if the plea of accident is to be accepted.[3] A living child was born precipitately while the mother was sitting over a bucket of water; the mother fainted and the child suffocated. Under the circumstances the death was undoubtedly accidental.[4] Leblond[5] reported a remarkable case of unconscious delivery to the Medico-Legal Society of Paris. A woman, aged twenty-seven, who had been seduced and deserted, was seized with slight colicky pains, but continued to work. Next night she had still sharper pains. Thinking that a motion would help her, she sat down upon a night-stool, and presently a living child was born. Though much alarmed, she managed to cut the cord, and, wrapping the child in a cloth, she carried it downstairs and told the people in the house what had happened. The cord was not tied. Next morning Leblond saw the patient and found the placenta still in the vagina. Mother and child did well. Had the child died the mother would probably have been suspected of intentionally neglecting her child, especially if she had gone to an outside privy.

---

[1] For a full report of three cases in which suffocation was effected by means of a feather-bed, the mother's hand, and wrapping in an apron, see Vierteljahrssch., 1891, i., 19.

[2] Répertoire de Pharmacie, January 10th, 1893.

[3] Vierteljahrssch. f. ger. Med., 1874, ii., 123.

[4] Friedreich's Blätter f. ger. Med., xxxvi., 64.

[5] Journal de Méd. de Paris, July 30th, 1893.

A similar case was admitted a short time ago into the Montreal Maternity. The mother, a servant-girl, continued her work till an urgent desire to defecate compelled her to go to the closet; in a few minutes a living child was born in the closet, but was rescued without suffering any damage. She was unaware that she was about giving birth to a child. In another similar case in Montreal the child was born into an old-fashioned pan-closet; the mother pulled up the lever and tried to force the child down into the soil-pipe. It was too large to pass down, but when it was examined subsequently its appearance proved that it had died in utero some time previously. Pullman[1] relates a case where there was no motive for concealment, in fact a child was earnestly desired. It was born unexpectedly, and was saved only by the timely appearance of the midwife.

Brouardel[2] says that the most important point in judging of such cases, is the position of the mother during delivery. He says a woman cannot bear a child in the upright position; if seized with labor when sitting on a closet, the child cannot be born into the closet, but must come out upon the front border of the seat. He also states that a full-term child cannot pass through an ordinary house-closet, because the diameter of the largest closet outlet is 12 cm., while the transverse diameter of a child at the shoulders is 18.2 cm.

While painless labor is not common in primiparæ, it may nevertheless occur. Brunon[3] reports such a case, where the child would have been born in a closet had the mother not got away just in time. It is therefore needful for the medical witness to weigh well all the facts of the case before deciding that the suffocation could not have been accidental, remembering that the finding of a child suffocated in a closet is not necessarily a proof that it was intentionally destroyed. In England it is very common for nursing infants to be suffocated at night while sleeping on the mother's breast, or by the mother rolling over upon them. The mother, exhausted by her day's work and sometimes more or less under the influence of liquor, sleeps heavily, unmindful of the child at her breast; in the morning she wakes up and finds her infant stiff and cold. In Liverpool on an average three inquests a week are held upon suffocated infants,[1] three-fourths of them being over one month and under one year old.

---

[1] Vierteljahrssch. f. ger. Med., April, 1891, i., 276.

[2] Gaz. des Hôpitaux, 1888, p. 109.

[3] Normandie Médicale, 1890.

The mother sometimes suffocates her child by putting her finger in its mouth to stop its crying. Hofmann and Liman mention three cases each, Schiller[2] one, and Wendel[3] three. In the first of Wendel's cases, immediately after birth the mother struck the child upon the head with some hard substance, then thrust the index finger of her left hand into its mouth and held it in the pharynx till the child died. She did this not so much to destroy the child as to prevent it from crying and betraying her secret. The throat has been plugged with straw for a similar purpose. In such cases marks of violence will be found about the mouth, tongue, and pharynx.

The post-mortem appearances of suffocation in new-born infants are similar to those observed in adults, provided respiration has been established. The most constant condition is engorgement of the internal organs (especially in the thorax). Subpleural and subpericardial ecchymoses occur in eighty per cent of the cases. Brouardel[4] says that these signs are commonly found in other conditions and are not by themselves a proof of violent suffocation. Some rely upon the bloodless condition of the spleen. Fritsch assigns but little forensic value to these ecchymoses, since they may be absent in undoubted cases of suffocation, and present even in the macerated fœtus. In eighteen autopsies on macerated infants performed in the Marburg Clinic, Klein found extravasations in seven, mostly under the pleura and pericardium. One of these cases was of particular interest. In a child born spontaneously, with commencing maceration, ecchymoses were found on the thoracic viscera, mucus with lanugo hairs in the trachea, and a subaponeurotic hemorrhage the whole length of the sagittal suture. Had the child been born before the commencement of maceration, and its body concealed, perhaps these post-mortem appearances might have justified an opinion of death from violence. When the autopsy shows signs of suffocation in a new-born child, Kustner says that a careful examination of the placenta will sometimes determine whether the suffocation occurred during or after birth.[1]

---

[1] Brit. Med. Jour., Jan., 1885, 186.

[2] Vierteljahrssch. f. ger. Med., xlvii., p. 297.

[3] Inaug. Dissert., p. 35.

[4] Gazette des Hôpitaux, 1880, p. 101.

Drowning may be accidental or intentional. It cannot be proved by medical evidence that death was caused by drowning unless respiration has been established. If the woman was delivered in a bath and the child was born under water and kept there till life was extinct, there would be no evidence post mortem of drowning. After respiration has been established, the appearances would be similar to those found in older children or adults.

When the body of a new-born infant is found in the water, it is important to determine whether the child was living or dead when put into the water, and whether death was caused by submersion or not.

It very commonly happens that an infant is destroyed in some other way, as by strangulation or suffocation, and is then thrown into the water to conceal the mode of death. It therefore does not follow that a child died by drowning, because its dead body was found in the water. In such cases a careful examination should be made for marks of violence, special attention being directed to the condition of the ears, nose, throat, respiratory passages, and stomach. A very small quantity of fluid may drown a child; enough water, liquor amnii, blood, etc., to cover the mouth and nose will suffice; complete submersion is not necessary. (See case 15.) The defence may plead that the child was dead-born and was thown into the water to conceal its birth; the medical witness will be called upon to say whether it was really dead-born, or had been born alive and breathed; in the latter case whether it was alive or dead when thrown into the water, and whether the submersion was the cause of death. Or the accused may admit that the child was born alive and breathed for a time, but may assert that it died from natural causes and was then thrown into the water for the purpose of concealment. The medical witness may be required to say whether death was from natural causes; if not, whether drowning was the cause.

---

[1] Vierteljahrs. f. ger. Med., iii. Folge, xv., 51.

Intrauterine asphyxia may occur from premature separation of the placenta or from compression of the cord. The existence of placenta prævia, the existence of blood-clots firmly attached to the placenta, give valuable information. A greenish coloring of the covering of the placenta and cord shows that there has been disturbance of placental respiration during birth.

If the water in which the body was found is some distance from the place where the child was born, it may be asked whether the mother was able or likely to have carried it such a distance so soon after being delivered. Women are sometimes capable of almost incredible exertion when trying to conceal the birth of an illegitimate child, therefore the medical witness should be careful how he denies the possibility of such exertion. Alison mentions the case of a woman two or three days confined, who walked twenty-eight miles in a day with a child on her back. It is not at all uncommon for women to walk several miles or do a hard day's work immediately after being confined.

If the child has been found drowned in a water-closet or night-stool or privy-vault, it may be claimed by the accused that labor came on unexpectedly, that she could not rise or secure assistance, and that the child dropped from her body, and was drowned in spite of all she could do. This story may be true or false, and the medical witness may be able to corroborate her statements, or show that they are not borne out by the post-mortem appearances. The cord may be found cut, not torn, or there may be marks of external violence disproving the story of unexpected, precipitate labor and accidental drowning of the child. (See case 21.)

Cold and exposure may readily destroy the life of a new-born child. There may be no marks of violence observable, and no post-mortem appearances to indicate the cause of death, except perhaps cerebral congestion. The evidence may be mostly circumstantial, and the medical witness may have no other grounds upon which to base his opinion than the place where the body was found, the season of the year, the temperature of the air, the length and kind of exposure, etc. To constitute murder, wilful malice must be proved; this is very hard to do, and convictions are rare.

Starvation is still harder to prove; it is often a factor in death by exposure. It may be necessary to test the stomach and intestine for the presence of food. Medical evidence is usually of slight value, and the case depends chiefly upon circumstantial evidence. If the child is immature or feeble, it is less able to take or digest food, and death is more likely to have occurred from natural causes.

Wounds may be the cause of death, or may be found on the body when death was due to other causes; they may have been produced accidentally or with criminal intent; they may have been inflicted during life or after death. The medical witness may have to determine whether they were sufficient to cause death, whether they were actually the cause of death, and whether they were accidental or homicidal.

Wounds in children present similar appearances to those in adults. In addition to the ordinary incised, lacerated, and contused wounds, there may be minute punctures and incisions cunningly contrived to cause fatal damage with very little external signs of their presence. The brain has been pierced by needles thrust through the fontanelles, the nose, and the orbit. Stannus[1] refers to punctures of the brain through the upper eyelid, and Dr. Handsel Griffiths[2] finds from experiments upon animals that fatal injury may be easily inflicted in this way, and is difficult to detect (Tidy). Taylor says that the spinal marrow has been wounded by needles or stilettoes introduced between the vertebræ, the skin having been drawn down before the wound was inflicted to give it a valvular and apparently superficial character. Incised wounds may be attributed by the defence to broken utensils, surgical instruments, or the accidental slipping of knife or scissors while cutting the cord. In that event the wounds are not likely to be multiple or extensive or accompanied with much violence, and the cord would be found cut, not torn.

If the body has been found dismembered or cut up, the accused may allege that it was born dead, and the mutilation was done to conceal the birth. The tests for live-birth would show the truth or falsity of such a plea.

Injuries to the Head.—The caput succedaneum and cephalæmatomata have been occasionally mistaken for bruising and swelling caused by violence. The caput succedaneum is an œdematous swelling on the presenting part, involving the skin and subcutaneous tissues but not the periosteum and bone; when incised, a serous or serosanguineous fluid exudes. A cephalæmatoma is an effusion of blood beneath the periosteum. These tumors are the result of pressure moulding the head so that it may be able to pass through the parturient canal. The smaller the head and the larger the pelvis, the less the liability to these swellings. Cephalæmatomata do not usually appear till the second or third day. If the labor has been difficult and prolonged there may be small ecchymoses of the scalp or pericranium, but no injury to the bones or scalp, and no signs of external violence; whereas in swellings caused by violence there will be more or less injury of the surface, effusion of blood, and perhaps fracture of the bone. (See case 14.)

---

[1] Irish Med. Gaz., August 15th, 1873.

[2] Lancet, October 11th, 1873, 519.

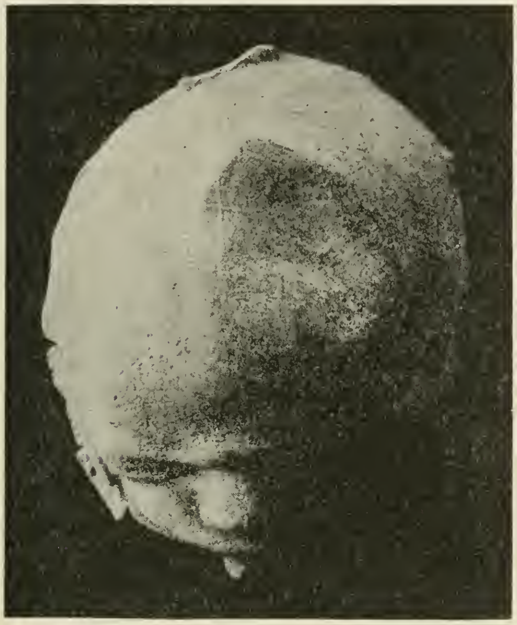


FIG. 34.—Spoon-shaped Depressed Fracture of Left Frontal Bone, the Result of Violent Uterine Action. (From Specimen in Museum of McGill University.)

The head will stand a certain amount of compression during labor without endangering the child's life, but if the limits be exceeded there may be intermeningeal extravasation, rupture of the sinuses, compression of the brain, or premature attempts at respiration. If disproportion exists between the head and the pelvic canal, especially if there be abnormal projection of the sacral promontory, the uterine efforts may cause a spoon-shaped depression upon the frontal or parietal bone.[1] It is quite possible, however, for such a depression to be caused by wilful violence after birth.[2] Bruises and wounds may be caused by the pressure of a forceps blade during instrumental delivery.

It will thus be seen that fractures, furrows, and indentations of the cranial bones may occur during instrumental delivery in contracted or deformed pelves, either from pressure of the forceps blades or the abnormal projection of some part of the pelvis, most frequently the sacral promontory.

---

[1] Vierteljahrssch. f. ger. Med., xxx., 260.

[2] Wien. Med. Presse, 1885, Nos. 18–28.

In European countries, where pelvic deformity is common, such accidents are not infrequent; and even when labor has been completed by the natural efforts, furrows and depressions are occasionally found. Though it is well known that intra-uterine fractures of long bones may be caused by violent uterine action, it does not seem to be generally recognized (in this country at least) that fractures of the cranial bones may be produced by unaided uterine contraction. Only under exceptional circumstances could such an accident happen, yet in a medico-legal examination the possibility should be borne in mind. The following case, which came under my own observation in the Rotunda Hospital, Dublin, was reported to the Obstetrical Society of that city by Dr. W. J. Smyly, then assistant master of the Rotunda.[1]

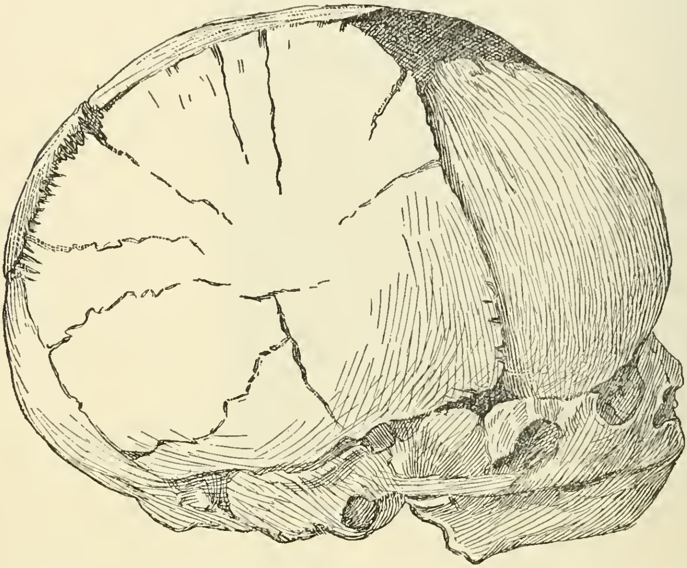


FIG. 35.—Skull of Child, after a Fall into a Cellar Ten Feet Deep, the Floor being Stone. The right parietal region struck first, the parietal protuberance was flattened and fissures radiated from the flattened area. (Lesser.)

In a healthy, strongly built woman, VIIpara, labor began about the end of the eighth month of pregnancy; head presenting, cord prolapsed and pulseless. Although pains continued strong and frequent, the head did not come down, but was found to be still above the brim eleven hours after rupture of the membranes. Then suddenly while a vaginal examination was being made, a violent uterine contraction drove it through the brim with a jerk, and labor terminated almost immediately. There was some difficulty in extracting the shoulders. The child had not been very long dead; there was no caput, no attempt at moulding, but a spoon-shaped depressed fracture of the left frontal bone. As the biparietal diameter could not pass the narrowed conjugate, the head could not engage in the brim or descend into the pelvis. It lay above the brim displaced to the left, with the forehead jammed against the projecting promontory; a sudden violent pain fractured and depressed the frontal bone, and labor terminated precipitately. This fracture could not have been distinguished post mortem from one produced after birth by direct violence.

---

[1] Obstet. Journal of Great Britain and Ireland, vi., 328.

It is even possible for the skull to be fractured by the compression it undergoes while being forced through a tough cervix.[1] In these exceptional cases there would be a history of difficult labor and the existence of disease or deformity in the pelvis. The ease of fracture depends on the extent of ossification; the greater the ossification, the easier the fracture.

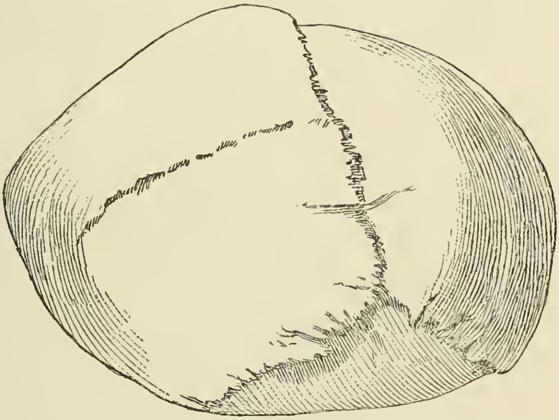


FIG. 36.—Fissure on Left Parietal Bone, Produced by Mother's being Delivered Standing on the Street, While on her Way to the Hospital. (Lesser.)

As a rule these accidental fractures are slight, rather in the form of fissures beginning at a suture or fontanelle and extending an inch or so into the substance of the bone. The frontal, temporal, and parietal bones are most likely to be fractured or fissured; in the majority of cases, it is the parietal.

---

[1] Edin. Med. and Surg. Journ., xxvi., 75.

Such injuries are usually slight and unaccompanied by ecchymoses and severe bruising or wounding of the scalp. But occasionally ecchymoses are found either outside or beneath the pericranium even after easy labors, generally in the vicinity of the sutures. They are caused by tearing of the vessels from the violence of the expulsive efforts.

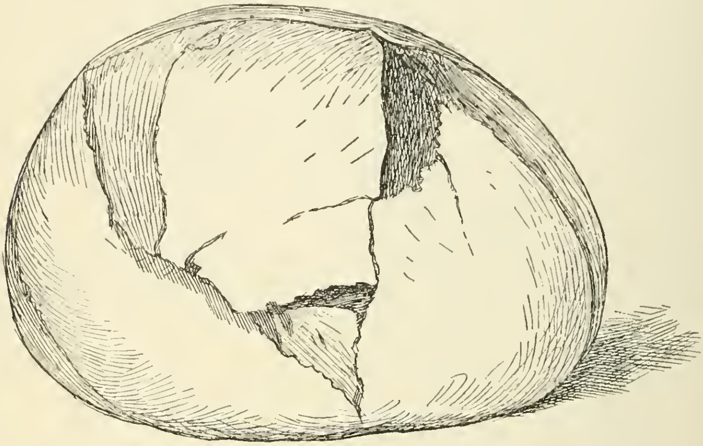


FIG. 37.—Fracture of Skull by Intentional Violence. (Lesser.)

Their forensic value depends upon the proof of live-birth. There would be no injury to the scalp or cranial bones, if they were produced by natural efforts while the child was still in utero. In fractures the result of criminal violence, the skin is generally lacerated and bruised, and in addition the cranial bones may be driven in, wounding the brain substance, or clots of blood may produce compression. The method of distinguishing between fractures during life and after death are practically the same for infants as for adults.

Care must be taken not to confound defects in ossification with fractures or the effects of criminal violence[1] (Fig. 39). Cranial bones may be fractured during difficult forceps-operations, especially over the orbital arches; the mark of the blade is easily made out, and should prevent error in diagnosis.

---

[1] Prag. Vierteljahrssch., cxxiii., 53; Schmidt's Jahrb., 1851, lxix., 224.

Fractures or fissures may occur in the same situation in cases terminated by natural efforts if the bones are thin and fragile.

Fractures of the skull are not necessarily fatal, whether occurring before or after birth. Henoch[1] reports two cases of holes in the skulls of infants under six months of age, which he attributes to fracture at the time of birth. He thinks that fissure is the first stage of the hole, absorption of the bone-salts occurring on each side of the line of fracture till a large aperture is formed. Cerebro-spinal fluid is apt to escape through a vent in the adherent dura and pia mater, and local inflammatory action finally destroys life. One case was over five months, the other about three months old. In the first there was a tense elastic tumor the size of a kidney over the right ear; it could be diminished by pressure, always increased when the child cried, and the light could be seen through it. When tapped, a clear albuminous fluid was obtained. In the second case a similar tumor lay to the right of the sagittal suture. The head may be severely injured in utero and be more or less completely repaired. Wendel[2] reports a case where the tabular portion of the occipital bone was fractured in utero; the process of repair was well advanced when the child was born. Priestley[3] reports a curious case in which there was found at birth a circular wound the size of a shilling situated over the posterior fontanelle, looking as if it had been punched out; the process of repair had begun. The mother was a multipara and the labor was easy. (Fig. 6, Pl. III.)

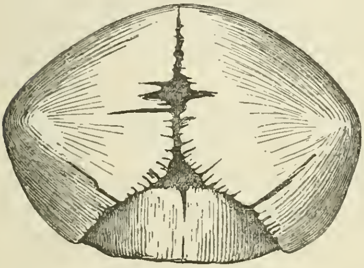


FIG. 38.—Fœtal Skull, Showing Accessory Fontanelle and Congenital Fissures in the Posterior Third of the Sagittal Suture; also Symmetrical Congenital Fissures in Lambdoid Sutures of Both Parietal Bones. Might be easily mistaken for results of mechanical violence. (Hofmann.)

Intra-uterine injuries may be sustained by the fœtus, without any recognizable marks being left on the mother's abdomen. Heavy blows on the abdomen with blunt instruments, or falls from a height, may injure or kill the child without seriously affecting the mother. Hofmann[1] mentions the case of a woman who was thrown down from a four-story window; the abdominal wall and uterus were uninjured, but the placenta was partially separated, the membranes torn, the right lobe of the liver ruptured and a quantity of blood effused into the abdominal cavity. In another case, there was a wound of the skin behind the left ear, an ecchymoses under the right breast and left thigh, and a transverse tear of the peritoneum over the right lobe of the liver. Charcot observed rupture of the spleen from a fall of the mother. Dietrich describes the case of a woman in the thirty-sixth week of pregnancy, who fell down a steep stair, and sixteen days afterward bore a child with a wound on both frontal protuberances; the edges were cicatrizing. In 1872 Tarnier[2] showed the Paris Surgical Society a day-old child with a cicatrix on the crown of the head, probably caused by an attempt to produce abortion by mechanical measures. Gurlt mentions two cases: in one a pregnant woman and her fœtus were wounded with a scythe, and in the other with a pitchfork; the children died, but the mothers recovered. Kehr reports a similar case from shooting.[3]

---

[1] Brit. Med. Journal, 1889, i., 32.

[2] Inaug. Dissert., p. 56.

[3] Trans. Lond. Obstet. Soc., 1860, i., 60.

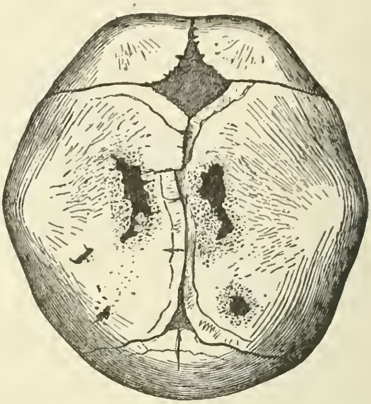


Fig. 39.—Ossification Defects in the Parietal Bones of a New-born Child. Might easily be mistaken for marks of violence. (Hofmann.)

Intra-uterine injuries most frequently affect the long bones, very rarely the cranial bones; in some of the reported cases the formation of callus was observed. Tidy says that a mare in foal fell into a quarry; her colt was subsequently born dead with a fractured skull. A costermonger kicked his donkey, which was near her foaling time; the young donkey when born had fracture of the foreleg and skull.

When the head of a new-born child is found to have been severely bruised or fractured the plea is sometimes advanced that the mother was suddenly taken with labor pains and the child was born while she was sitting, standing, or kneeling, and that the injuries found upon the child's head were due to the fall. It is quite possible for such an accident to happen,[1] and bruising may occur, but fracture is not common. If it does occur, it will most likely be in the form of fissure unless the fall has been great. (See cases 8, 11, 37.) Multiple fractures and extensive marks of violence would tend to negative the theory of accident.

---

[1] Hofmann: "Lehrb. f. ger. Med.," 9th ed., p. 817.

[2] Union Médicale, 1872, No. 33.

[3] Med. Centralbl., 1894, p. 336. See also Paul's case, Prag. med. Woch., 1894, No. 45.

A child born in the way indicated may live for several days and finally die of convulsions, and the autopsy may reveal fracture of the skull and compression of the brain by a blood-clot, although no signs of external violence may be present.

Each case must, therefore be decided upon its own merits, and no rules can be formulated which will apply to all cases.

Occasionally the child may be destroyed by dislocation of the cervical vertebræ and injury to the cord produced by extreme or forcible rotation. This may happen in forceps cases, especially while attempts are being made to correct malpositions, or in breech cases in the extraction of the head. Such injuries are generally accidental and are easily recognized by the post-mortem examination.

Occasionally a new-born child may be put into the fire and burned, and the question may arise as to whether it was alive or dead when the burning took place. If the body is so charred that evidence of live-birth cannot be obtained, the medical evidence will not be able to decide.

When marks of violence are found upon the head or body of the child, which cannot be explained by violent uterine action or accidental fall, the usual defence is that they were accidentally inflicted while the mother was struggling to complete her own delivery. The law humanely recognizes the possibility of a woman's being frenzied by pain while the child is passing through the vulva, and rendered unaccountable for her actions. She may be deprived of judgment and may destroy or injure her child. A case came under my observation where a woman seized her child as it was passing through the vulva, dragged it forcibly out and flung it through an open window. In a case reported by Callere, the mother strangled her child immediately after its birth. It was proved that the woman was suffering from acute hysteria, and that she had been subject to such attacks. The plea was admitted.

---

[1] Med. Times and Gazette, 1860, ii. 219; Lancet, 1861, i. 13; Amer. Journ. Med. Sciences, 1861, 279.

It is quite possible for a woman to injure her child severely while trying to hasten her delivery. She may seize the head or neck with both hands, scratch and bruise the face and neck with her nails and fingers; there may be finger-marks upon the neck, extravasations of blood in the sterno-cleido-mastoids, dislocation of the cervical vertebræ, but not fracture of the skull. The shape, direction, and situation of the marks distinguish them from other kinds of violence. (See case 35.)

Marks of violence inflicted by the mother are not sufficient in the eye of the law to prove infanticide; there must be evidence to show that the violence was committed knowingly and intentionally.

Strangulation.—It is not always possible for the medical evidence to decide whether strangulation has been accidental or criminal. The defence usually claims that death was accidental, having been due to the coiling of the cord about the child's neck or body. In such cases the twisting of the cord generally takes place in utero, and death is caused by pressure on the cord and arrest of the fœtal circulation, not by strangulation at all. Consequently in the majority of such cases the child dies before birth, before it has breathed, and the lungs are found to be in the fœtal state. But when the coils have really prevented the access of air to the lungs by constricting the neck, and the child has strangled, the probability is that the cord was twisted around the neck after birth and the child purposely destroyed. (See cases 1, 2.)

It may, therefore, be said that as a rule death has been accidental when the lungs are in the fœtal state, homicidal when they have been expanded.

Much stress has been laid upon the appearance of marks of the cord on the neck; these are broad, shiny, depressed streaks, sometimes livid and discolored, which encircle the neck; when incised, they show signs of ecchymosis. Not much reliance can be placed upon these marks for medico-legal purposes; they may be found in accidental cases and may be absent in homicidal cases where undoubtedly much violence has been used. If a ligature or cord has been twisted tightly about the neck during life, in all likelihood there will be swelling and œdema of the tissues above and below the constriction. (See case 12.)

Neither depression, lividity, nor ecchymoses (if slight) can be depended upon to distinguish positively between accidental and criminal strangulation. However, in criminal cases more violence is used than necessary, and the mark of the cord is apt to be deeper, broader, and more ecchymosed; there may be also extravasation of blood, abrasions and lacerations of the skin, and injuries to the windpipe and muscles of the neck. In accidental cases there is no injury to the skin and underlying parts, and the lividity and ecchymoses are slight and partial. It is entirely a question of degree, but it is improbable that the cord could be accidentally tightened during birth so as to produce marks resembling those resulting from criminal violence, while at the same time the child is able to breathe sufficiently to expand its lungs fully with air.

The post-mortem examination of the lungs is therefore of the utmost importance in such cases. It may be alleged by the defence that the head was delivered but that the cord was too short to permit any further advance, and that the child breathed but perished before it could be completely delivered.

Even severe compression is not necessarily fatal, for occasionally children are born alive with marked depressions on the neck from pressure of the cord.

It is not possible to determine, from external appearances only, whether the constriction was applied to the neck during life or shortly after death. Casper holds that if applied within an hour, the marks cannot be distinguished from those made on a living body. Reubold's views are different. He attributes the mark of the cord to the peculiar distribution of the fat in the new-born and its high melting point, and says that the cord must remain *in situ* until the body has cooled if marks of constriction are to be found. (See case 36.) It is also impossible for the medical witness to say whether the compression was effected before or after the child was completely born, before or after the cord was divided.

Division of the cord has no legal significance; a child may be legally born though its cord is not divided; or again its cord may be divided and yet the child may not be legally born.

Not all livid marks upon the neck have been caused by pressure of the cord. Depressed marks are often produced in the front of the neck by forcibly flexing the head on the chest, especially if the neck is fat and the weather warm. These appearances may be produced equally well upon the dead body, if it is still warm.

It has been claimed that the os uteri may constrict the neck with sufficient force to produce a livid streak. I have often seen on the necks of still-born children marks which were not distinguishable from those produced by the compression of the cord. Finger-marks and nævi have sometimes been mistaken for marks of the cord.

It is evident therefore that external appearances have only a relative value in determining whether death was due to strangulation or not, whether the constriction was accidental or wilful, and whether it was applied before, during, or after birth, before or after death. Yet a minute examination should be made of the external appearances in all cases, for occasionally valuable evidence is obtained therefrom. More reliance, however, is to be placed upon the examination of the lungs.

Hanging is rarely the cause of death in new-born infants. The signs are the same as in adults. (See Vol. II., pp. 252 *et seq.*)

Poisoning is also a rare cause of death. Opium in the form of soothing-syrup is probably the commonest poison. When the mother is addicted to morphia, her nursing infant is sometimes poisoned through her milk. Several cases of fatal morphia poisoning in this way have been reported. Hofmann mentions a case where a young woman poisoned her two-days-old child with nux vomica. Arsenic and phosphorus have occasionally been administered. (See case 33.) Caustics have been introduced into the mouth on sponges or cloths. Even if poison is detected, it is always difficult to trace the crime and fasten the guilt upon the administrator with sufficient certainty to secure conviction.

METHOD OF PERFORMING A POST-MORTEM EXAMINATION UPON A NEW-BORN CHILD FOR MEDICO-LEGAL PURPOSES.

The post-mortem examination is a very important matter in cases of infanticide which come to trial. No physician should attempt to make such an examination, unless he has made himself familiar with the correct and approved methods. Unless he follows the proper sequence, he will be unable to obtain all the information that is possible or necessary, and it will then be impossible to repair his mistake. The technique differs somewhat from that of an ordinary post-mortem. The external examination should be more minute, and the internal examination should be made so as to determine the actual cause of death, and exclude all others which might be suggested. Full directions are given in Chartier's monograph,[1] Vibert's[2] medical jurisprudence, etc. Some useful hints may also be found in a recent lecture by Dr. Cattell,[3] of Philadelphia; his method of evisceration is specially worthy of notice.

The following taken from Vibert's handbook gives concisely the proper order and the principal points:

1. Note the sex.
2. Determine the length. Extend completely the lower limbs, place a rod vertically and as a tangent to the vertex, measure with a rigid rule the distance between this rod and the soles of the feet.
3. Determine the weight; if the placenta is still attached to the body, separate it and weigh it separately.
4. Measure the antero-posterior and biparietal diameters of the head.
5. State of the umbilical cord; soft or dry; length, if evenly divided torn or broken, if it is ligatured; if there are signs of commencing separation at its base.
6. Note putrefaction; its degree.
7. Condition of the surface of the body; if soiled with blood, meconium, or foreign matters. Presence and position of vernix.
8. Congestion of face; ecchymoses of conjunctivæ.
9. Marks of violence on body, describe them minutely. Make on the face and anterior part of the neck a number of incisions close together, through the cellular-adipose tissue, to determine whether there are any subcutaneous ecchymoses.
10. Incise the sides of the mouth following the labial commissures; see if there are foreign bodies in the cavities of the mouth and pharynx, or traces of violence on the tongue, sides of mouth, and pharynx.
11. Disarticulate one of the halves of the inferior maxilla, raise it and detach the gum; make a section of the free borders and see whether there exist four alveolar dental compartments.

---

[1] Chartier: "Examen Médico-légal et Autopsie des Enfants Nouveau-nés," Lyon, 1890.

[2] Vibert: "Précis de Médecine Légale," Paris, 1893.

[3] Cattell: "Some Special Points on the Performance of Autopsies on the Newborn," Annals of Gyn. and Pædiatry, 1893, p. 758.

12.[1] Open the knee-joint, divide the cartilage of the lower extremity of the bone in thin sections, perpendicular to the axis of the bone; find and measure the point of ossification. (Fig. 7, Pl. III.)

13. See if there are marks of violence in the deeper parts of the neck; extravasations of blood, muscular tears; detach the carotids from the base of the neck to their bifurcation, and see if ecchymoses exist on their external surface or tears of the internal coat.

14. Open the larynx and trachea; note if they contain any froth or foreign bodies; condition of the mucous membrane.

15. Open the œsophagus.

16. Examine the condition of the spinal column.

17. Incise the skin, beginning at the base of the neck, passing downward over the thorax outside the nipple, down over the abdomen to the pubes, and pass upward on the other side. Avoid wounding the intestines and abdominal organs. The anterior wall of the abdomen being raised, divide the anterior and lateral attachments of the diaphragm, divide the ribs at the line of the cutaneous incision with strong scissors or a costotome.

18. Note the volume of the lungs, condition of the large vessels of the thorax (fulness, emptiness, injection of walls).

19. Cut across the trachea and œsophagus at the base of the neck; take out *en bloc* the lungs, heart, and thymus.

20. Examine the surface of the lungs; note their color, the presence of subpleural ecchymoses, patches of emphysema, or putrefaction. Punctate ecchymoses of the costal pleuræ and diaphragmatic aspect of thymus.

21. Plunge into the water the lungs, heart, and thymus, and apply the hydrostatic test.

22. Congestion of the lungs; quantity of blood and froth which exudes when a fragment is squeezed between the fingers.

Foreign bodies in the bronchi (blood, mucus, meconium, fæcal matters, etc.).

23. Condition of the heart; subpericardial ecchymoses; quantity of liquid or coagulated blood contained in its cavities.[1]

---

[1] Numbers 10, 11, 12, can be more conveniently done at the conclusion of the examination.

[2] In certain cases it is better to open the heart when still *in situ;* it is easier then to appreciate the quantity of blood which it contains, a portion of which almost always escapes while the thoracic organs are being removed and the hydrostatic test applied.

24. Separate the stomach by cutting the inferior extremity of the œsophagus and the middle portion of the duodenum: open it under water to see whether it contains air or gas; note whether the mucus is mixed with bubbles of gas more or less fine and numerous. Foreign bodies.

25. Examine the intestine; if it contains gas; quantity of meconium in the large intestine. Is the anus imperforate?

26. Liver; its degree of congestion; state of umbilical vessels.

27. Kidneys; uric acid infarcts.

28. Other abdominal viscera; anomalies.

29. Incision of scalp in a circular line passing above the ears; raise it. Sero-sanguineous tumor; its site and volume. Epicranial ecchymoses, abundant or not. Effusion of blood above or beneath the periosteum. Congestion of cranial envelopes.

30. Detach the periosteum and ascertain whether the bones are fractured. Note abnormal thinness, lacunæ, or fissures.

31. Open the cranium by means of a saw or strong scissors introduced through the anterior fontanelle and directed along the front parietal suture, then transversely behind, dividing the parietal and occipital bones. Note whether there is extravasation of blood on the surface of the brain.

32. Take out the brain and examine its different parts; note the degree of congestion of it and the meninges.

33. Open the spinal column by sawing through the bodies of the vertebræ. Examine the cord, especially the cervical portion.[1]

A very good way of examining the mouth and pharynx of new-born children in cases of suspected infanticide, has been described by Hubert.[2] His method is as follows: The usual section in the middle line over the sternum is prolonged through the soft parts of the under-jaw, that is, through the chin and under-lip. One blade of sharp-pointed scissors is passed immediately behind the alveolar process, in the middle line, from above downward, and the mandibula divided. The halves of the lower jaw can then be separated and thrown backward on each side, affording a complete view of the mouth and pharynx without disturbing any foreign body which may be located there. The tongue can be drawn forward or to one side as may be most convenient. The advantages claimed are facility of execution, thoroughness of investigation, with the minimum disturbance of the parts and disfigurement of the cadaver.

---

[1] Opening the spinal column can very often be omitted. It is examined only if it is suspected that the neck has been twisted.

[2] Friedr. Blät. f. ger. Med., 1887.

It is sometimes difficult to find the ossific centres in the os calcis and astragalus. The following method was suggested by the late Dr. Wyatt Johnston, coroner's physician, Montreal: Make a single diagonal incision from the fold of the ankle-joint anteriorly, to the tip of the heel posteriorly. The section will pass through the ossific centres of the astragalus and calcaneum, or very close to them, avoiding the necessity of a number of sections.

ILLUSTRATIVE CASES—INFANTICIDE.

1. *Strangulation by the Umbilical Cord. Vierteljahrssch. f. ger. Med., xlvi., p.* 81 (Winter).—A patient, æt. 27, IIIpara, normal pelvis, head presenting in second position of vertex, membranes ruptured for ten days; duration of labor twelve hours. Head arrested in pelvis for eight hours, when pains, which had been very strong, ceased. Forceps applied, but difficulty in delivering on account of cord coiled around the neck. Child born dead.

Post-mortem, seven hours after birth. Skin of whole head and face dark-blue and œdematous. especially about the eyes. A broad circular mark about the neck. In *cranial cavity*, veins distended with blood. Membranes and brain-substance very œdematous—no fluid blood in ventricles and cranial cavity, cranial bones intact.

Thorax: lungs collapsed; deep dark ecchymoses over both pulmonary pleuræ in their whole extent and over the pericardium. Lungs airless but contain much blood. Trachea free, but mucous membrane very hyperæmic. Epiglottis œdematous, so that the opening of larynx was almost covered over. Liver congested, hemorrhage in the kidneys.

2. *Strangulation by the Cord—Hemorrhage in Lateral Ventricles. Ibid.* (Winter).—IIpara, æt. 21. Normal pelvis; hydramnios. After twelve hours of weak pains, the membranes ruptured and the waters came away with meconium. Four hours later came the head, but the midwife could not deliver the shoulders on account of the cord being coiled around the neck. In five minutes a physician came and cut the cord and delivered a child deeply asphyxiated, which was partially resuscitated, breathed imperfectly, and died in eight hours.

Post-mortem, ten hours after death. In the cranial cavity the sinuses were distended with blood, and under the pia mater was a lot of clotted blood which had flattened out the brain substance. Vessels of pia engorged, brain substance soft, both lateral ventricles filled with blood-clot. Medulla much flattened with fluid and clotted blood. Much serum in both pleural cavities. Ecchymoses on pleura and pericardium. Small extravasations under the mucous membrane of false vocal cords. Lungs collapsed and almost airless. Ecchymoses in kidney.

3. *Large Intracranial Hemorrhage—Death in Five Days. Ibid.* (Winter).—Vpara, twins. The first born spontaneously, head presenting. The second turned by external cephalic version and delivered spontaneously in six hours. In the second child, soon after birth, ptosis of the right upper lid was noticed, and weak general convulsions. It could not move or swallow and died in five days.

Post-mortem, twenty-four hours after death. A large clot compressed brain in right frontal and parietal regions; brain substance softened; no wounding of sinus could be found or the point whence hemorrhage came.

4. *Airless Lungs in Well-Developed Child that Lived Six Hours. Ibid.* (Winter).—IIIpara, æt. 23. Spontaneous birth; child cried after birth but grew gradually weaker and died in six hours.

Post-mortem, twenty-four hours after death. Membranes of brain deeply injected, especially the pia. Brain-substance soft and congested, lungs dark-bluish red, airless, somewhat lighter in color at the edges. Sank in water. Ecchymoses in pleura, especially of lower lobe.

5. *Air in Stomach and Intestines of Dead-Born Child. Ibid.* (Winter).—IXpara, æt. 36. Early rupture of membranes, tedious labor, transverse presentation; physometra, child died in utero; version and extraction. No attempt at resuscitation.

Post-mortem in twenty hours. Many large and small ecchymoses on pericranium, pia injected, great œdema of cerebral membranes. Many ecchymoses in brain-substance. Lungs collapsed, bluish-red, airless, ecchymosed, a few patches containing air found on section. Mucus mixed with meconium found in trachea. Stomach and whole intestinal canal nearly as far as the colon filled with air. In the lower part, no meconium. Both kidneys congested, with hemorrhage into the connective tissues.

6–9. *Four cases of death from natural or accidental causes, in which appearances existed which might have been mistaken for evidence of criminal interference.*

6. *Death from Cerebral Hemorrhage during Labor—No Signs of Violence. Unpublished* (Wyatt Johnston).—The body of a well-formed new-born male infant was found wrapped in heavy wrapping-paper. Around the body was a torn white cotton cloth stained with meconium but showing no traces of blood or of having been wetted. There was a very large caput. Dissection showed a slight meningeal hemorrhage along the region of the fissure of Sylvius, and a blood-clot the size of an almond in the region of the medulla. The lungs were

airless and sank in water; the stomach empty and airless. Meconium in both large and small intestines. No external marks of violence.

7. *Case of Syphilitic Hepatization—No Marks of Violence. Unpublished* (Wyatt Johnston).—Coroner's inquest held on the body of an immature male infant of about the fifth month. Cord had been tied and cut. Heart, surface pale and yellowish; portions of heart muscle examined under the microscope show a number of coarse, highly refractive granules in the muscular fibre, varying from 1 to 3 mm. in diam., insoluble in strong acetic acid, stained black but not intensely by osmic acid solution, and completely dissolved by chloroform, showing them to be probably some preliminary stage of degenerative fat. Lungs pale, and whitish-gray in color, lobulation very distinct, quite airless. Microscopic sections of lung show moderate amount of catarrhal exudate in most of the air-cells. Condition appears to be that of commencing white hepatization.

8. *Child Born Enveloped in Membranes—Injury to Head by Fall on Floor. Unpublished* (Wyatt Johnston).—A coroner's inquest was held on a fœtus of about eight months. After the membranes had ruptured and the waters drained away, the fœtus enclosed in the amniotic sac with placenta attached was expelled in a single pain, the fœtus striking the floor with its head. The lungs were airless, but ecchymoses beneath the pleura and pericardium indicate that death was due to asphyxia, probably from the close adaptation of the membranes to the child's face. About the left parietal and occipital regions, there is a moderate amount of reddish serum beneath the scalp, and a few small ecchymoses beneath the pericranium in this region. On opening the skull, a thin layer of coagulum is seen covering the hemispheres at or about the site of the external injury.

9. *Accidental Suffocation by a curd of milk, probably vomited. Unpublished* (Wyatt Johnston).—A coroner's inquest was held recently on the body of a new-born child, found dead. The body was quite fresh, well-nourished, and at about the end of the eighth month. Umbilical cord 2½ inches long with line of demarcation formed, and retraction of vessels. No signs of violence externally or about mouth and pharynx. In the pharynx were small masses of curd; one of them, the size of a bean, was wedged in the larynx completely obstructing it. A little turbid fluid was found in the trachea. Stomach contained about a teaspoonful of acid curdy fluid, in which were found, microscopically, oil-globules but no traces of starch. Heart filled with thick fluid blood. No ecchymoses on pleura or pericardium.

10. *Was Death due to Hemorrhage from the Torn Cord, Exposure to Cold, or Violence? Eulen. Vierteljahrssch., N. F., xlii., p.* 315 (Langsdorff).—A widow, the mother of four children and near full term, set out to walk to a relative's house some miles away. She felt

pains before starting. While passing through a wood she was taken with active labor and bore a living child. She said that she cut the cord with her finger-nail and threw the placenta into the bushes, placed the child in a basket and covered it over with a cloth. The weather was cold and unpleasant, and when she reached her destination the child was dead but still warm. Upon examination, it was established that the child was born alive, had lived a short time, and died of suffocation, probably the result of violence, the mouth and nose being forcibly closed with the hand. The lung, stomach, and intestinal appearances were those of live-birth. The engorgement of the heart with blood, the congestion of the brain and viscera, and the numerous ecchymoses pointed to death by suffocation. About the nose, mouth, and chin were bluish discolorations and excoriations corresponding in situation and extent to the fingers and thumb of the mother's right hand. There were blue spots on the back of both hands, due to the mother's holding them in her left hand while the child was struggling for breath. Hemorrhage from the cord was excluded because the vessels were full of blood, not empty; and there was not a sufficient quantity of blood lost to cause the death of a strong child. Exposure to cold was excluded because the weather was not cold enough to freeze, and moreover the body was warm when she reached her relative's house. That death occurred soon after birth was proved by the relatively empty condition of the stomach, bowel, and bladder, as well as by the appearance of the stump of the cord. No food was found in the stomach. The stump was fresh, soft, and not beginning to dry; only the end was of a brownish color.

11. *Accidental Asphyxia by Fœtal Membranes.* (*Vibert: Précis de Médecine Légale, Paris,* 1893, *p.* 732).—Ipara, æt. 19, accused of infanticide.

Post-mortem on body of child: Cord and placenta still attached to the body. A piece of the membranes still adherent to the placenta, covered the mouth and nose entirely. No marks of violence on the body. No foreign matters in mouth and pharynx. Larynx and trachea contain a small quantity of colorless froth. Lungs fill the thoracic cavity and float on water. Ecchymoses on diaphragm, pleura, and pericardium. A number of blackish spots the size of a pea scattered regularly over the whole pulmonary surface. Cavities of heart distended with dark liquid blood; no clots. Stomach contains mucus and a small quantity of gas. Small intestine empty, large intestine filled with meconium. Liver large and congested. Spleen and kidneys normal; bladder contains a little urine. Scalp is unbroken, no effusion of blood beneath it. No fractures of cranial bones. Meninges are congested and pia mater presents a fine vascular injection. No effusion of blood within skull. The opinion given was that the child was at full term, was born alive, and died from asphyxia caused by the occlusion of mouth and nose by a portion of fœtal membranes commonly known as the the *caul*.

12. *Infanticide by Strangulation. Ibid., p.* 733.—Post-mortem on child born at full term. Putrefaction has not begun. Around the neck is a black lace, drawn very tight and secured with a double knot, it passes horizontally around the neck below the larynx. It leaves on the skin a deep furrow, blue in color, but not parchment-like. On the right side of the neck the furrow is double, with a ridge of skin between; red and projecting. No marks of violence on the face or other parts of the body. On dissection of the neck, an ecchymosis is found 7 mm. in diameter on the anterior surface of the trachea. On the left carotid, the internal membrane presents a tear occupying about three-fourths of the periphery of the vessel; an effusion of blood exists in the tissues on a level with this tear. Larynx and trachea empty, their mucous membrane being white, slightly reddened. Lungs are voluminous and float in water. Numerous fine subpleural ecchymoses. Heart ecchymosed and cavities distended with fluid blood. Stomach contains mucus and a little air. Liver bulky and congested. No fractures of cranial bones. On the surface of both hemispheres are extensive thin layers of coagulated blood. At the base about three to four grammes of liquid blood. It was concluded that the child had breathed and was strangled by a ligature tied tightly around the neck.

13. *Infanticide by Fracture of the Skull. Ibid., p.* 734.—Post-mortem on body of child which had reached full term. Cord is torn away at a point 17 cm. from the abdomen and not tied. Putrefaction has not begun. On various parts of the body, especially about face and neck, are wounds, erosions, ecchymoses, and other signs of external violence. No foreign bodies in mouth and pharynx. Larynx and trachea contain a little froth. No marks of violence in the deep parts of neck. Lungs bulky and congested and float in water. A dozen fine ecchymoses under pleura. Lung substance contains a large quantity of blood and froth. Heart contains liquid blood, but no subpericardial ecchymoses. Stomach contains mucus. No air in stomach or intestine. Large intestine filled with meconium. Liver large and congested. Under the scalp on right side is a large extravasation of blood mostly coagulated. Right parietal bone is broken into fine pieces, two of which are completely detached and depressed. Left parietal bone also fractured in a single line from the parietal protuberance to the sagittal suture. Beneath the skull is a blood-clot 1–2 mm. thick covering almost the whole superior surface of the right cerebral hemisphere; at the site of fracture it is thicker, irregular, and partly surrounds the fragments of bone. The conclusion was that the child was born alive and death was caused by fracture of the skull.

14. *Fracture of Skull during Delivery of Hydrocephalic Child. Trans. Obstet. Soc. London, xxix.*, 1887, *p.* 405 (Swayne).—A primi

para had been a long time in labor; the first stage had been tedious, the waters having come away early. The head was found pressing down upon the perineum but not advancing on account of its large size. It was perforated in the sagittal suture, a quantity of liquid gushed out, the skull collapsed, and the child was then delivered without difficulty. It was found that the long-continued pressure against the pelvis had caused extensive ecchymosis around the left eye and a fracture of the right parietal bone.

15. *Was Death due to Injuries to the Head, Hemorrhage from the Untied Cord, or Suffocation (Drowning in a Stable Drain)? Eulenberg's Vierteljahrssch. f. ger. Med., i.*, 32.—The body of a new-born child was disinterred and examined by order of the court eighteen days after birth. It was full term and well developed, had been born alive and lived for a short time. There were several injuries about the head, a ragged wound on the scalp and fissures of both parietals. The lungs showed evidence of breathing, but the upper lobes were of a clear white color, the lower lobes clear and bluish, and over the surface were numerous small pale-red spots and marbling. Spleen, kidneys, and liver moderately full of blood; mesentery and omentum less so. Vena cava filled with bluish-red blood; the right heart contained more blood than the left. Two blades of grass were found in the upper part of the larynx.

The injuries to the head lacked the bloody appearance of the edges and neighborhood of the wound and other signs of having been inflicted during life. They were attributed therefore to violence during burial. Hemorrhage from the untied cord was excluded not only on account of its rarity, but also because the internal organs were congested and not bloodless as they would have been after death from hemorrhage; moreover there was no trace of blood about the end of the cord. The presence of the blades of grass could only be accounted for by supposing that they were drawn in during inspiration. Death was attributed therefore to suffocation, the child having lain for a time face downward in the fluids running along the stable drain.

16. *Accidental Death in Precipitate Labor. Brit. Amer. Journal of Med. and Phys. Science, i., p.* 116 (Sewell).—Mrs. B., æt. 30, married, Ipara. After a large fire in Quebec, which destroyed her home, she occupied a garret with two or three other families and some young men. When labor set in she bore her pains in silence throughout the night, from motives of delicacy. At daylight she went downstairs to a room occupied by a married woman. She had hardly seated herself upon the edge of a rather high chair when a severe pain seized her; the child was forcibly expelled before assistance could be given; it fell head foremost to the floor and was killed instantly. Two women were witnesses of the accident.

17. *Infanticide by Means of a Sponge. Lyon Médicale, Dec.* 4th,

1892. *Noticed in N. Y. Med. Journ.*, *i.*, 1893, *p.* 167 (Prof. Cazeneuve). —An infant, æt. five months, died suddenly. Suspicion having been aroused, an examination of the body was made seven months afterward. In the intestines were found seven rounded bodies the size of beans, which proved to be pieces of sponge. They had probably been administered in milk or soup, the finger being used in the back of the throat to assist the swallowing. Convulsions set in and the child died in sixteen hours. Professor Cazeneuve states that in England infanticide is committed by forcing into the pharynx a sponge to which a string had been tied; after the child is dead the sponge is pulled out and no signs of violence are left.

18–20. *Three Cases of Infanticide from Stoppage of the Air-Passage with Soft Obstructions.* 18. *Vierteljahrssch. f. ger. Med.*, 1891, *i.*, *p.* 19. *Smothering with a Feather-Bed.*—A full-term living child born during the night was found dead next morning. The post-mortem showed that it was mature, had breathed, and died of suffocation. There were no marks of violence. Nothing in mouth or upper air-passages. Nothing aspirated into lungs. Child had been heard to cry, and the mother said it had died soon after. There were three possible ways in which death might have been caused. Suffocation between the mother's thighs, under the bedclothes, or rolled up in the padded garment into which it was born. The mother was anxious to smother the child's cries; she found it hard to do this with her thighs, so she pulled down the feather-bed which served as an upper bed-cover, and wrapped the child in that.

19. *Smothering with the Mother's Hand.*—The child was new-born, mature, had breathed and lived, and then died of suffocation. What was the cause? The mother had already borne a child and this one's head was small, therefore labor was probably easy. She was not delivered in her bed, because she slept in a room with eight other girls, and the bed was not soiled and no clots of blood were found about it. Nor was the child born in the privy, for no traces of blood were found there. Probably in a sodded plot of ground before the house, but the marks were washed away by the rain. Post-mortem examination showed that death occurred immediately after birth. The lungs were but slightly distended. There were finger-marks on the left side of the neck, but not in such a position as to suggest strangling. Immediately after the child was born, the mother put her left hand over the child's mouth, and pressed her fingers against the left side of its neck, while she kept the air from entering the mouth.

20. *Wrapping in an Apron.*—A child was found in a basket wrapped up in an apron; there were some clothes on top, and the basket was covered with a woollen cloth. There were no marks of external violence, but the post-mortem showed evidence of slow suffocation. There were numerous ecchymoses and large effusions of blood under

the soft cranial coverings, unconnected with any traumatisms. There was a large amount of frothy, bloody mucus in the bronchi, therefore the opinion was given that the child was alive when it was wrapped up and placed in the basket.

21. *Case where the Plea of Accidental Death from Precipitate Labor was Successfully Refuted. Friedr. Blätter*, *xxxvi.*, 224 (Rauscher). A woman, æt. 30, while visiting a neighbor was seized with labor pains, went to the privy, and in a quarter of an hour came out and called to a person who was passing to hurry, for her child had come and had fallen into the privy. A living child was rescued, soiled with fæces, with a bluish swelling on the right side of the neck, and bleeding from the mouth. A physician testified that the swelling was due to strong pressure on the neck, the indented mark of one finger-nail being quite perceptible. The mother went back to the house from the privy, and a midwife extracted the placenta and attended to the child. The mother claimed that labor came on so rapidly that she could not get help, that the severity of her pain prevented her from rescuing the child, and that the injury to the neck came from its falling upon frozen fæcal matter in the privy. The person who removed the child from the pit said that she found it lying on its back; its back, heels, and back of head were covered with filth. The midwife testified that one hour after its birth the child was weak, bleeding from the mouth, and that the swelling on the right side of the neck was the size of a hen's egg, and increased or diminished in size according as blood flowed from the mouth. There were no scratches on left hand, back, or right temple. The cord was torn off and was about a foot long. Next day when she returned the child was dead. The post-mortem showed a full-term child which had been born alive and lived for thirty-three hours in spite of severe injuries to the neck which caused such hemorrhage as to interfere with breathing and cause slow suffocation. The opinion was given that death was due to suffocation from bleeding caused by violence to the neck. Were the injuries accidental or purposely inflicted? The mother claims that she fell upon a harrow-tooth two days previously and might thus have injured the child. This explanation is untenable, because no signs of injury were found on her abdomen, pointing to such an accident. Could the child have fallen upon frozen fæces and injured its neck? It did not fall on its right side, because it was smeared with fæcal matter on the back, back of head and heels, not on the side. There were no signs of fæces on or about the right side of the neck and in the neighborhood of the swelling. There was no ground to prove the suddenness of the birth or the absence of ability to get help or save the child. The mother's story was proved to be false in every particular.

22–24. *Cases of Injuries from Schultze's Method of Resuscitation in Asphyxia Neonatorum. Vierteljahrssch. f. ger. Med.*, *xlvi.*, *p.* 83

et seq. (Winter).—22. A woman, æt. 26, Vpara, with lateral placenta prævia. Combined podalic version was performed, followed immediately by extraction. The child was deeply asphyxiated. Schultze's method was employed, but the child was not resuscitated. Post-mortem, the scrotum was found much swollen and dark-blue. When incised, black blood spurted out. Pressure on scrotum forced blood into abdominal cavity. The abdomen contained free blood, lungs contained air and floated on water. Some ecchymoses on the pleura. Trachea and bronchi free.

23. A Vpara bore a child spontaneously. Cord prolapsed. Child deeply asphyxiated, not restored after long-continued use of Schultze's method. At the post-mortem held twenty-four hours after birth, the sinuses and veins of the pia mater were found engorged, and a general capillary injection of the brain substance, which was soft. The abdomen contained much fluid blood. The peritoneal covering of the liver was completely separated; between it and the liver was a small amount of fluid blood. In one part of the left lobe, the peritoneal covering was completely torn through. In the left inguinal region and right lumbar region were large subperitoneal extravasations. Blood could be squeezed from the scrotum into the abdominal cavity, and vice versa. The lungs were somewhat collapsed, light-colored, anæmic, and contained air throughout. The third, fourth, and fifth ribs on the right side were fractured about 1 mm. from the epiphysis. No hæmothorax.

24. A IIpara bore twins in the 36th week. The first was born spontaneously, forehead presenting. The second presented by the breech, but was quickly and easily extracted. It was deeply asphyxiated and Schultze's method tried unsuccessfully. At the post-mortem there was engorgement of the sinuses and pia mater and an extravasation of blood beneath and behind the pia. The tabular portion of the occipital bone was broken away from the basilar portion. Both lungs contained air. Much fluid blood was contained in the abdomen. The peritoneum was separated from the convex surface of the liver and torn in several places. There was an extravasation of blood in the right inguinal region.

25–28. *Four Cases of Air Found in the Lungs of Dead-born Children. Vierteljahrssch. f. ger. Med., D. F., iii., p.* 30.—25. *Turning and Extraction—Dead-born Child with Lungs Distended—No Attempts at Resuscitation.* A IIpara, æt. 24, with a simple flat pelvis, was delivered of twins. The first came spontaneously, the second had prolapsed cord; podalic version was performed, the os not being fully open. Heart-sounds were good but gradually became weaker; after rapid extraction, heart was not beating. There was a deep depression on the left parietal bone. Post-mortem, ecchymoses were found on the pericardium. The lungs were well filled with air.

26. *Extraction in a Footling Case—Dead-Born—Air-Filled Patch in the Right Lung—No Artificial Respiration.*—Ipara, æt. 27, with a simple flat pelvis. Early rupture of membranes. Heart-sounds good till spontaneous delivery of breech. Extraction of upper part of chest was difficult through a narrow, rigid os. Arms freed with difficulty. Head delivered twenty minutes later. Deep depression on left parietal bone. Post-mortem, no ecchymoses on costal or pulmonary pleura nor on the heart. In upper lobe of right lung was a piece the size of a pea containing air. Vessels of pia moderately filled. No cerebral hemorrhage. The important point in this case is that the child was undoubtedly dead before extraction of the head was begun, so that air found its way to the child's mouth and thence to the lung, although no intra-uterine manipulations had been performed. Also the absence of ecchymoses is noteworthy, notwithstanding undoubted death by suffocation.

27. *Extraction in Breech Presentation—Rupture of Dorsal Spine—A Spot of Lung Containing Air in Left Lung of a Dead-Born Child.*—In a IIIpara, æt. 29, eight hours after the death of the child, a foot was seized and extraction begun. The delivery of the chest was difficult, the spine gave way, the thorax lengthened out and came easily as far as the shoulder-blades. Delivery of arms and head difficult. Post-mortem, numerous ecchymoses were found on pleura and pericardium. In the middle lobe of the right lung was a patch containing air. There was some tympanitis uteri. As the child had been dead for eight hours, air must have got into the lung either by the child's inspiring air which had entered the uterus during an examination, or from putrefactive gases in the uterus, or after death from mechanical force during extraction. This last supposition is generally denied. If it were possible for air to be forced into the lungs of a dead-born child during artificial manipulations, it would be necessary to admit the possibility of air being forced into the lungs in a similar manner during its spontaneous delivery.

28. *Turning and Extraction in a Transverse Presentation—Air Found in Both Lungs of a Dead-Born Child.*—Ipara, æt. 23, normal pelvis, thorax deeply wedged in. Liquor amnii drained away for two days. Turning and extraction. Child beginning to macerate. Post-mortem, a moderate number of extravasations under pleura and pericardium. Both upper lobes and middle lobes of right lung atelectatic. In both lower lobes numerous spots filled with air. In this case the air could easily get into the uterus; the liquor amnii was a long time away and repeated examinations were made.

29. *Case of Infanticide—Peculiar Mummification of the Cord. Liverpool Med. and Chir. Journ., July*, 1889 (Lowndes).—The body of a large mature child was found in a coal-cellar with a silk handkerchief tied so tightly about its neck that the finger could not be pushed

between it and the skin. The aspect of the umbilical cord was the most peculiar and interesting feature of the case. It was quite fresh for half an inch from the umbilicus; the rest, two and a half inches long, was completely mummified ; there was no trace of ligature. As the weather was cold, the body was remarkably fresh, and it was probable that the child had been born eleven or twelve days previously. It had breathed, but the stomach was empty. All the internal organs were more or less congested, proving that the child had not died of hemorrhage. The opinion was given that the child had lived at least twenty-four hours.

30. *Case of Infanticide—Had a Criminal Abortion been Produced? Annales d'Hygiène*, 1889, *xxi.*, *p.* 418 (Tarnier).—On November 1st, 1888, a cook, æt. 39, was arrested for infanticide. Several persons had noticed for some months that she was growing stouter, as if pregnant. She had been in the habit of giving out her soiled linen to a laundress, but had washed it herself for some months so that it could not be ascertained whether her courses had stopped or not. On the night of October 20th, she had got up out of bed and gone into a cow-stable or privy close by. The following morning she complained of migraine, went up to her room and shut herself up. In the afternoon, her door being open, a servant went in and found her lying down and looking very ill. The following morning she got up and went to work; her mistress remarking that she was very pale, accused said that she had her menses and had lost a great deal. On November 1st, the police found several spots of blood on the floor of her room and two chemises spotted with blood. A parcel of clothing soiled with blood was subsequently discovered. The accused admitted that she might be four months pregnant, but strenuously denied having been confined. On October 31st, she was examined by a physician, who found a sero-purulent discharge coming from the genitals having the odor of the lochia. The fourchette was torn 2–3 cm., the edges of the wound were healing. There were also some small excoriations in the vagina. The cervix uteri was soft, dilated, fissured, and admitted the introduction of a finger. The uterus was larger than normal. No striæ. Milk could be squeezed from the breasts. The opinion was given that the accused had been confined at least eight days. Another physician was instructed to examine the woman on November 3d, and gave it as his opinion that one of the two following conditions existed:

1. That the accused had been confined twelve to fourteen days previously, the lesions in the cervix and at the fourchette being due to delivery; or
2. That abortion, by external means, had been attempted by the accused, probably with the aid of an accomplice.

He inclined to the latter supposition for the following reasons:

(1) The cervix giving passage to a large head would have been torn

throughout its whole thickness, and not only exteriorly; it would not have retained the regularity noticed in the examination.

(2) The breasts would have been larger and containing more milk.

(3) Striæ would have been more pronounced.

(4) The vulvar tear would not have been single, without swelling distortion or distention of neighboring parts.

(5) Complicity cannot be proved, but would be necessary to produce the injuries observed.

M. Tarnier was then commissioned to give his opinion of the case from the reports of the two physicians submitted to him. His conclusions were as follows:

(1) The sero-purulent discharge from the genitals, the increased size of the uterus, the easy introduction of the finger into the cervix, the secretion of milk prove that the accused had been pregnant, but do not indicate the period at which the product of conception had been expelled.

(2) The absence of striæ, the breasts slightly enlarged and not tending to become flaccid, the milk in small quantity and flowing out only on pressure, the cervix incompletely torn, a single tear at the vulva without swelling, tearing, or distention of the neighboring parts are commonly enough seen in women confined at or near term. These facts do not prove that pregnancy had been terminated by abortion.

(3) The hypothesis of criminal abortion is rejected absolutely, for the lesions would have been different from those found in this case.

(4) After a spontaneous or criminal abortion, we would find neither an extensive tear of the fourchette, nor such lesions of the cervix, while such lesions are often found after labor at term, even if it is spontaneous and easy.

(5) The extent of the tear at the fourchette, the lesions of the cervix, the cicatrization still incomplete, prove that the accused was confined at or near full term.

31. *Infanticide—Fracture of Skull from External Violence.* 1889. *Sammlung ger. Gutacht, Berlin* (Becker).—A servant-girl bore a child, which was found dead in her bed in the morning. She claimed that after the child was born she tried to get something out of a chest to wrap it in, when she fell unconscious to the floor; the child may have fallen on the floor and struck its head. At the post-mortem, blood could be squeezed from the right ear. The right temporal region was swollen and blue, and on section much blood came away. On the left side of the occiput the scalp is swollen. The inner surface of the scalp is generally bloody, also the pericranium. A thick black extravasation of blood extends from the right ear to the occiput. The right temporal muscle is permeated with a quantity of blood, the

left is pale-red. On the left side of the occiput is a brawny swelling of the scalp and periosteum containing much blood. The cranial bones show four fractures: three on the left parietal bone, 3 to 5 cm. long, extending from the lambdoidal suture to the parietal protuberance; one on the right parietal bone, 5 cm. long, extending from the parietal suture over the protuberance. The brain was covered with blood. A quantity of free dark blood in and through the brain. A number of extravasation points in the brain-substance. The opinion was given that such injuries could not have been produced during a natural labor, especially as the pelvis was found to be of normal size, nor by a fall upon its head. The most probable explanation is, that the accused holding the child in her hands swung it so that its head struck several times and with great force against the foot of the bed or edge ofthe chest, upon which marks of blood were found.

32. *Case of Vagitus Uterinus. Edin. Med. and Surg. Journal, xxxiii., p.* 215 (Holmes).—On November 29th, 1828, I was called to a lady in labor of her sixth child. The fontanelle presented, but the pelvis being capacious and her labors generally easy, no attempt was made to change the position. The head continuing to descend, the mouth lay on the pubes and the examining finger could easily be introduced into it. The occiput did not yet occupy fully the cavity of the sacrum. At this time I heard sounds like the cries of a child whose mouth was muffled by some covering, but not being very distinct and not being at all prepared for them, I thought when they ceased that they must have been produced by flatus in the intestines of the mother. In the course of a short time, however, the cries were repeated and with the greatest distinctness, so as not to admit of a doubt that they proceeded from the child. The mother, much alarmed, inquired the cause of these noises, and required to be assured they were not indicative of any danger. The pains being brisk, the head was soon forced down and expelled. The child was a female and is still alive and thriving.

33. *Infanticide by Phosphorus Poisoning. Annales d'Hyg. Pub.*, 1868, *xxix.*, 117 (Tardieu).—There were signs of violent gastro-intestinal inflammation. Chemical analysis showed free phosphorus, sulfur, and red chromate of lead. There were a number of fragments of sulfur in the texture of the child's clothing. Thirty-four matches had been macerated in a watery liquid, nine having their tops scraped off with a sharp instrument. The fluid so prepared was administered to the child.

34. *Case of Attempted Abortion, Infanticide, and Successful Concealment of Birth* (Cameron).—Ipara, æt. 26, of spare build and small frame. When two months pregnant, she took two ounces of oil of sandal-wood to produce abortion. She had convulsions and was very ill for some days, but was saved by prompt evacuation of the stomach. She went on to eight months, doing her work as a general servant without

exciting suspicion as to her condition. She says that she fell down stairs and was prematurely confined of a living child, but it is highly probable that she induced labor herself. She was alone when the child was born, and some time afterward the placenta came away. She wrapped the child in a cloth and then in newspapers, and went on with her work. Some workmen were filling in a drain which they had been digging in the yard; while they were away at dinner she buried the child in the excavation, and when they returned they filled in the earth and finished the drain. She felt ill and complained of pain for several days, but continued her work. On the eighth day she consulted a physician, who found a temperature of 100⅕°, and a purulent discharge, but no evidence of sepsis. She was sent to hospital, no suspicion having been aroused in the house as to her condition.

35. *Infanticide or Culpable Negligence? Vierteljahrs. f. ger. Med., Berlin, iii. Folge, xi.*, 310 (Commick).—The mother had concealed her pregnancy and borne her child prematurely. It was found still living, with the cord torn away from its body; half an hour afterward it died. There were found extensive injuries of the lower jaw, consisting of a triple fracture, with denudation and dislocation of the fractured ends, deep wounds in the floor of the mouth and about the root of the tongue, extravasation of blood in the laryngeal muscles and about the arytenoid cartilage, and extensive injuries about the larynx. While the intentional infliction of these injuries could not be excluded, it was held that most probably they were caused by the woman's rough attempts to extract the child. After the birth of the head, the fingers were hooked in the mouth, and later they were clasped about the neck to extract the trunk. She was found guilty of culpable negligence.

36. *Attempted Infanticide. Friedreich's Blätter f. ger. Med., xlvii.*, 21 (Reubold). The child was found in a locked trunk which had to be forced open. About the neck was a piece of handkerchief tied so tightly that it was removed with difficulty. Although the child was deeply asphyxiated, it was resuscitated, and no marks of strangulation and no furrows remained on the neck. Reubold says that furrows, depressions, and imprints from a cord or handkerchief about the neck can occur only when the constricting materials have remained *in situ* until after death and the cooling of the body. The peculiar distribution of the fat in the new-born, and its high melting-point (45° C., 113° F.), cause these compression and constriction marks to stand out very prominently in dead bodies.

37. *Infanticide or Death from Natural Causes during Birth in a Standing Posture? Vierteljahrs. f. ger. Med., Berlin, iii. Folge, xii.*, 146 (Teufel).

The accused concealed the birth, and, according to her own admission, struck the child's head against the stove. At the autopsy, four weeks afterward, there was a double fracture of the left parietal bone corresponding to the lines of ossification, and proceeding from the parietal eminence. There were no signs of the umbilical cord on the child, although on the placenta there was a piece 6 cm. long, which had been cut smooth. The lungs were for the most part empty of air. From these observations it was concluded that the cord had been torn off at its abdominal insertion, and that therefore the child must have dropped downward when born, that it must have breathed only incompletely, and that at the time when its head was dashed against the stove it was already dead. The injuries to the skull were typical of those found in birth in the standing or sitting position (*Sturz-geburt*); and if the child had really been destroyed by violence, more severe and extensive injuries would have been expected in the skull. The woman was found guilty of attempted infanticide upon an *unsuitable object* (a child already dead). Teufel concludes that a torn cord favors the theory of birth in a standing position, as do the site and extent of the cranial fractures. Extensive injuries to the skull involving several bones would favor the theory of criminal violence. The imperfect inflation of the lung favors the theory of *Sturz-geburt*, although complete inflation may occur if the child lives some time after birth.

FORENSIC MEDICINE.

BIOLOGICAL.

WHEN MEDICAL EXAMINATION OR OTHER INSPECTION OF LIVING HUMAN BODY IS PERMITTED OR REQUIRED BY COURTS OF LAW

BY

TRACY C. BECKER, A.B., LL.B.,

Counsellor-at-Law: Professor of Criminal Law and Medical Jurisprudence, Law Department of the University of Buffalo.

WHEN MEDICAL EXAMINATION
OR OTHER
INSPECTION OF LIVING HUMAN BODY
IS REQUIRED OR PERMITTED
BY COURTS OF LAW.

IN CRIMINAL CASES.

In criminal cases it frequently becomes necessary for the criminal courts to determine questions of capacity to commit crime arising in cases of alleged infancy, idiocy, or lunacy.

Inspection or Examination to Determine Age.

At common law, infants under the age of seven years were conclusively presumed to be incapable of possessing the intelligence to know and understand the nature and quality of a criminal act, or of possessing the necessary amount of will power to formulate a criminal intent. Infants between the ages of seven and fourteen years were presumed incapable of possessing these qualifications for committing crime, not as a matter of law, but as a matter of fact, and the presumption thus arising, like any other presumption of fact, could be overcome by the prosecution offering evidence establishing, beyond a reasonable doubt, that an infant did in fact know and understand the nature and quality of the act and that it was unlawful. The burden was on the prosecution to offer such proof of capacity. Persons over fourteen years of age were presumed to be fully capable of committing crime.[1]

---

[1] Allen *v.* U. S., 150 U. S., 551.
Many of the United States have changed the ages of capacity from those prescribed by common law; thus: *Arizona*—Children under ten incapable unless clearly shown they

The question of non-age was at the earliest period of the common law tried by a jury of eight men (Glanvil, L. 13, Chap. 15); but, as Blackstone states (3 Blacks. Comm., 332), "when for the greater expedition of the cause in some point or issue, being either the principal question or arising collaterally out of it, but being evidently the object of senses, the judges of the court upon the testimony of their own sense shall decide the point in dispute. For, where the affirmative or negative of a question is matter of such obvious determination, it is not thought necessary to summon a jury to decide it. . . . If, however, the court has upon inspection any doubt of the age of the party (as may frequently be the case) it may proceed to take proofs of the fact; and particularly, may examine the infant himself upon an oath of *voire dire*, *veritatem dicere*, that is to make true answer to such questions as the court shall demand of him; or the court may examine his mother, his godfather, or the like."[1]

So also in Union Pac. R. R. Co. against Botsford (141 U. S. Reps., 250, 252) the United States Supreme Court said: "In former times the English courts of common law might, if they saw fit, try by inspection or examination without the aid of a jury the questions of the infancy or of the identity of a party," and cited in support of the statement the doctrine quoted from Blackstone above.

In the States of New York and Minnesota and perhaps elsewhere the practice in such cases has been regulated by express legislative enactment.[2] In other States, which follow the common law, the common-law rule might be adopted, though the

---

knew wrongfulness of act (Ariz. Penal Code, sec. 24). *Arkansas*—Infants under twelve inacapable as matter of law, between twelve and fourteen as matter of fact (Ark. Digest of Stat., 1894, chap. 48, secs. 1441, 1442). *Colorado*—Infants under ten years of age presumed incapable as a matter of law; ten to fourteen as a matter of fact (Col. Gen. Stats., sec. 1159). *Illinois*—Same rule (Ill. Crim. Code, ¶¶ 461, 462). *Minnesota*—Infants over seven and under twelve years of age presumed incapable as a matter of fact (Minn. Penal Code, sec. 17). *New York*—Infants between seven and twelve years of age presumed incapable as a matter of fact (New York Penal Code, sec. 19). *Texas*—Infants between nine and thirteen years of age presumed incapable as a matter of fact (Texas Penal Code, art. 34). And a person shall in no case be punished with death for an offence committed before he reached the age of seventeen (Pasch. Dig., art. 1639), etc.

[1] See also State *v.* Arnold, 13 Ired. Law (35 N.C.), 184, holding that the infant is bound to produce such evidence, it being a matter peculiarly within his knowledge.

[2] By section 19, New York Penal Code, it is provided that "whenever in any legal proceedings it becomes necessary to determine the age of a child, the child may be produced for a personal inspection to enable the

question of age would probably be for the jury trying a criminal case. It should be noted, however, that Article 5 of the United States Constitution, providing that the defendant may not be compelled in a criminal case to become a witness against himself, would doubtless limit the power of the court to order an examination of the person of an infant. But if the alleged infant voluntarily appears as a witness, the jury may undoubtedly take into consideration his appearance in determining his age.[1]

INSANITY IN CRIMINAL CASES.

The practice in cases where a defendant in a criminal action pleads insanity, or where he apparently becomes insane after he has been indicted, will be fully considered in the article on Insanity in the next volume of this treatise. It is sufficient for the present to say that this practice is regulated in the most of the United States and in England and her colonies by express statutory provisions. Some of these statutes require that a portion of the jury or commission should be medical men, or that medical men should be required to examine the defendant and testify before the court or jury. But in spite of gradual improvement in the statutory regulation of these matters, a great advance is still possible in most of the States of the United States.

The common-law practice of trying an issue raised by a plea of insanity, alleged to exist at the time of the commission of a crime, that is, of trying it, the same as any other issue of fact, by jury, is the universal practice in such cases.

PREGNANCY IN CAPITAL CASES.

When a female convicted of a capital offence, and sentenced to the punishment of death, apparently becomes pregnant, it has been the rule in all civilized countries to ascertain by proper inspection and examination whether she is so pregnant, and, if

---

magistrate, court, or jury to determine the age thereby, and the court or magistrate may direct an examination by one or more physicians, whose opinion shall also be competent evidence upon the question of age." By Minn. Penal Code, sec. 17, the court is given power to require the production of a child for examination by a magistrate, court, or jury, to determine its age, and may require an examination by one or more physicians whose opinions are declared to be "competent evidence on the question of age."

[1] State *v.* Thomson, 155 Mo., 300.

she is found to be so, to suspend sentence until after she has given birth to her child. In certain States and countries this examination is required by statute to be made or participated in by medical men, and in others there is no special provision in that respect; but it is the modern practice generally to summon before the court or jury trying the question medical experts who have had an opportunity of making a physical examination of the defendant.[1]

The early common-law rule of practice was to empanel a jury of matrons *de ventre inspiciendo*. Of this practice Wharton, in his work on Criminal Law, sec. 3402, observes: "In the frequency of capital punishments in the old English practice, it was not uncommon for female prisoners to claim the benefit of the law that no woman should be executed while she is quick with child. The practice under such circumstances was for the woman, when called prior to sentence to say whether she had anything to allege why sentence of death should not be passed upon her, to plead orally her pregnancy, upon which the sheriff was forthwith directed to empanel a jury of matrons. The jury being sworn to inquire as to whether the prisoner is 'quick with child,' they retired with the prisoner, and the court was governed by their verdict to the same extent that it would be by the verdict of a jury empanelled to try any issue of fact. In the hearing before the jury, surgeons may be called to testify as experts. If the verdict be found in the defendant's favor, she is respited from session to session until the delivery of the child."[2]

---

[1] Examples of such statutes are as follows: Arizona Penal Code, secs. 1032, 1033, requires a jury of three physicians. California Penal Code, secs. 1225, 1226, a jury of three physicians. Idaho Rev. Stats. [1901], secs. 5557, 5558, a jury of three physicians. Massachusetts R. L. [1902], chap. 220, secs. 41–43: "Must appear to the satisfaction of the Governor and Council," who would undoubtedly summon physicians. Minnesota, Stats. of 1894. sec. 7407, "to the satisfaction of the Governor," who would undoubtedly call a physician. Mississippi Code of 1892, sec. 1450, "six physicians, if to be had; if not, six discreet householders." Missouri Rev. Stats. of 1899, secs. 2671–2672, a jury of six, at least three of whom must be physicians. Montana Codes, Ann. [1895], secs. 2252, 2253, a jury of three physicians. Nebraska Crim. Code, secs. 554, 555, a jury of six persons. Nevada Comp. Laws 1900, sec. 4448, "a jury of three physicians." New York Code of Crim. Proced., sec. 500: Sheriff of county where conviction takes place must empanel a jury of six physicians to inquire as to pregnancy. North Dakota Rev. Codes [1899], sec. 8314, jury of three physicians. Oklahoma Stats. 1893, sec. 5308, "a jury of three physicians, etc."

[2] See also 4 Black. Comm., 395; 1 Hale P. C., 369, 370; Reg. *v.* Wycherly, 8 C. and P., 262; State *v.* Arden, 1 Bay. Rep. (S. C.), 487; Haleman *v.* State, 13 Ark., 105.

It may safely be said that the writ *de ventre inspiciendo* is obsolete in America.

IN CIVIL CASES.

Disputed Heirship.

The writ *de ventre inspiciendo*, says Blackstone, was also allowed by common law, in a matter of civil right, to protect the rightful succession to the property of a deceased person against fraudulent claims of bastards, when a widow was suspected to feign herself with child, in order to produce a supposititious heir to the estate, in which case the heir or devisee might have this writ to examine whether she was with child or not, and, if she was, to keep her under proper restraint till delivered (1 Bl. Com., 456; Bac. Ab. Bastard, A). And the United States Supreme Court said in the Botsford case: "In cases of that class the writ has been issued in England in quite recent times. *In re* Blakemore, 14 Law Journal, Ch., 336."[1]

The learned court said further, however: "But the learning and research of the counsel for the plaintiff in error have failed to produce an instance of its having been considered in any part of the United States as suited to the habits and condition of the people." In Roberts *v.* Ogdensburgh & L. C. R. R. Co., 29 Hun, N. Y., 154, 156, the court, *per* Learned, P. J., remarked: "The writ *de ventre inspiciendo* (1 Bl. Com., 456), taken by the English law from the Roman Dig., 25, 4, 1, 10, *and made indecent in taking*, has long become obsolete," and the same observation is made by the same court concerning appeals of mayhem and the like, which are mentioned in 3 Bl. Com., 332, 333, referred to *supra*. There is, therefore, under the modern system of administering justice, in the absence of any statute, no special or peculiar method or practice in use for determining cases of disputed heirship.

Cases of Impotency, Alleged in Actions for Divorce.

In Devanbagh *v.* Devanbagh, 5 Paige, 558, the Court of Chancery in New York State held that in an action for divorce on the ground of impotency the court had power to compel submission by the plaintiff or defendant to a surgical examination, placing the opinion on the ground that from the very nature of the case other proof was impossible.[1] And this case has been generally followed in the United States.[2]

---

[1] Un. Pac. R. R. Co. *v.* Botsford, 141 U. S. Rep., 253. See also *ex parte* Aiscough, 2 P. Wms., 593.

AGE IN CIVIL CASES.

When non-age is pleaded in a civil case, it is treated like any other question of fact. A jury may in determining the question take into consideration the alleged infant's appearance in court.[3]

INSANITY IN CIVIL CASES.

The practice in this class of cases, that is, commissions *de lunatico inquirendo* and the like, is, as in criminal cases, generally regulated by statutes, which will be collated and referred to fully in the articles on Insanity in Vol. III. The general rule is that proceedings for determining the sanity of a person, in order to have a committee appointed to care for his person or property, must be had before a court or jury; but, as in cases of inquiry where criminals are alleged to be insane, there is still a lamentable insufficiency of provisions for a proper examination by medical experts.[4]

EXAMINATION OF PLAINTIFF IN CIVIL ACTIONS TO RECOVER DAMAGES FOR PERSONAL INJURIES.

WHETHER OR NOT COMPELLABLE IN ABSENCE OF STATUTE.

As stated in Vol. I. of this treatise, at pages 85, 86, "It has been much discussed whether the defendant in a malpractice or other negligence case can compel the plaintiff to permit his person to be examined by physicians before trial, to enable the defendant to know the full extent of the injury so far as it is perceptible. In the latest cases the examination of the plaintiff before trial was not allowed unless expressly permitted by statute."[1]

---

[1] Roberts *v.* O. & L. C. R. R. Co., *supra;* Cahn *v.* Cahn, 21 Misc. (N. Y.), 506; People *ex rel.* Mosher *v.* Roosa, 43 App. Div. (N. Y.), 611; 2 Bishop Mar. & Div., sec. 590. And in the Botsford case, above cited, the court said that this authority rests upon the interest which the public as well as the parties have in the question of upholding or dissolving the marriage state, and upon the necessity of such evidence to enable the court to exercise its jurisdiction, and is derived from the civil and canon law as administered in the spiritual and ecclesiastical courts, not proceeding in any respect according to the courts of the common law; citing Briggs *v.* Morgan, 2 Hagg. Con., 324; s. c., 3 Phillimore, 325. And see also Beck's "Med. Jurisprudence," p. 89, in reference to infrequency of cases of absolute or incurable impotency; also vol. 2, p. 638, of this work; and see Browne on "Divorce," 5th edition, p. 195.

[2] Anonymous, 35 Ala., 226; Anonymous, 89 Ala., 291; Le Barron *v.* Le Barron, 35 Vt., 365; but see Shafto *v.* Shafto, 28 N. J. Eq., 34; also 2 Western L. J., 131; see New York cases cited in the last note.

[3] Black *v.* Pate, 130 Ala., 514 (age of a voter); see Wigmore on Evidence, vol. 1, sec. 222.

[4] In Connecticut (Gen. Stats. [1902], sec. 2768) the inquisition is referred to a jury consisting of *a physician, an attorney at law, judge or justice of the peace, and one other person.* Under the Georgia Code [1895], sec. 2573, the question of insanity is determined by a jury of not less than twelve nor more than eighteen, at least one of whom must be a physician. In Ill. Rev. Stats. [1901, Hurd], chap. 85, secs. 4 and 6, triable by jury, or by commission of two physicians. Kan. Gen. Stats. [1901], chap. 60, sec. 5, provide for a jury of six men, one of whom must be a physician. Minn. Stats. [1895], sec.

In spite of the concurrence of the highest courts of the United States and so many States of the Union, it would seem doubtful whether the rule in the majority of States is not still that the court has inherent power to compel a party to submit to such an examination,[2] provided it can be made without danger, discomfort, or humiliation.[3] On a question of this character, the decision of the United States Supreme Court is not controlling in the State courts.

Statutory Provisions for Examination.

The legislatures of at least two States, New York and New Jersey, have recognized the propriety and desirability, for the furtherance of justice in actions to recover damages for personal injuries, of enabling the defendant to have the plaintiff examined, under proper restrictions, by competent physicians

---

4680, require a jury of two persons, one of whom must be a physician. New York Code of Civ. Proced., sec. 2330, requires a jury of not less than twelve nor more than twenty-four indifferent persons, or a trial jury in a court of record, but there is no provision for examination by a physician or that a physician should be summoned to sit on the jury.

[1] Citing: Union Pac. R. R. Co. *v.* Botsford, 141 U. S., 250; McQuigan *v.* Del., L. & W. R. R. Co., 129 N. Y., 50; Roberts *v.* Ogdensburg & L. C. R. Co., 29 Hun, 154. See also Cole *v.* Fall Brook Coal Co., 159 N. Y., 59, 69; *Delaware:* Mills *v.* Wilmington City Ry. Co., 1 Marv., 269; *Illinois:* Pittsburg, etc., Ry. Co. *v.* Story, 104 Ill. App., 132; *Massachusetts:* Stack *v.* R. R. Co., 177 Mass., 155; *Oklahoma:* Kingfisher *v.* Altizer, 13 Okl., 121; *Texas:* Austin, etc., Ry. Co. *v.* Cluck, 77 S. W. R., 403; *England:* Newham *v.* Tate, 1 Arnold, 244; Turquand *v.* Strand Union, 8 Dowl., 201.

[2] *Alabama:* Alabama G. S. Ry. Co. *v.* Hill, 90 Ala., 71; *Arkansas:* Sibley *v.* Smith, 46 Ark., 275; *Georgia:* Richmond, etc., Ry Co. *v.* Childress, 82 Ga., 719; *Indiana:* South Bend *v.* Turner, 156 Ind., 418; *Iowa:* Schroeder *v.* Chicago, R. I. & P. R. R., 47 Iowa, 375; *Kansas:* Ottawa *v.* Gilliland, 63 Kan., 165; *Kentucky:* Louisville & N. R. R. Co. *v.* Simpson, 111 Ky., 754; *Michigan:* Graves *v.* Battle Creek, 95 Mich., 266; *Minnesota:* Hatfield *v.* St. Paul & D. R. Co., 33 Minn., 130; *Missouri:* Sidekum *v.* Wabash R. R. Co., 93 Mo. 400; *Nebraska:* Stuart *v.* Havens, 17 Neb., 211; *North Dakota:* Brown *v.* Chicago, etc., R. R. Co., 12 N. D., 61; *Ohio:* Miami, etc., Turnpike Co. *v.* Baily, 37 Ohio St., 104; *Pennsylvania:* Hess *v.* Lake Shore & M. S. R. R. Co., 7 Pa. Co. Ct., 565; *Washington:* Lane *v.* Spokane, etc., R. R. Co., 21 Wash., 119; *Wisconsin:* White *v.* Milwaukee C. R.R. Co., 61 Wis., 536.

[3] South Bend *v.* Turner, 156 Ind., 418; Louisville & N. R. R. Co. *v.* Hartlege, 25 Ky. Law, 152; Atchison, T. & S. F. R. R. Co. *v.* Palmore, 68 Kan., 545; O'Brien *v.* La Cross, 99 Wis., 421.

designated by the court.[1] The importance and value of these provisions to the medical profession as a protection against dishonest malpractice suits cannot be overestimated.

REFUSAL OF PLAINTIFF TO SUBMIT TO MEDICAL EXAMINATION, WHEN ADMISSIBLE IN EVIDENCE.

An interesting question arises in those States in which an inspection and examination of the person of the plaintiff in personal injury cases is held by the courts not to be compellable against plaintiff's will, as to whether the refusal of the plaintiff to submit his person to an examination can be shown upon the trial for the purpose of permitting the jury to draw the inference that the plaintiff was not as severely injured as he claimed. In Elfers *v.* Wooley, 116 N. Y., 294, the court held that a charge to the jury that it might take into consideration the fact that the plaintiff had refused to permit his person to be examined by a physician, when requested to do so by the defendant, as bearing upon the credibility of the plaintiff's statement concerning his injuries, was not error. The court also held that it was not error for the trial court to refuse to charge the jury that the refusal of the plaintiff to submit to such an examination raised a presumption that his injuries were not as severe as he claimed. Mr. Justice Holmes, writing for the Supreme Court of Massachusetts,[2] while holding that the court had no power to order an examination, said: "No doubt, in general, a refusal to be examined by a proper doctor sent by the other side would be admissible in evidence, and would be a proper subject for severe comment and a ground for adverse inference, at the very least (Freeport *v.* Isbell, 93 Ill., 381)." And this would seem to be the law, for the cases refusing to order an examination are decided on the ground of lack of power in the court in the absence of a statute, not on any absolute right of the party to refuse to be examined.

---

[1] *New York* (Code of Civil Procedure, sec. 873): When defendant ignorant as to injuries, examination before trial by one or more physicians designated by court, before the judge or a referee. The examination may be oral. *Held*, constitutional, in Lyon *v.* Manhattan Railway Co., 142 N. Y., 298. *New Jersey* (Laws of 1896, c. 202, p. 344): Court may order examination at or before trial by one or more physicians, etc. *Held*, constitutional, McGovern *v.* Hope, 63 N. J. Law, 76; and see Camden, etc., R. R. Co. *v.* Stetson, 177 U. S., 172.

[2] Stack *v.* New York, N. H. & H. R. R. Co., 177 Mass., 155, 159.

PREGNANCY, LABOR, AND THE PUERPERAL STATE.

BY

J. CLIFTON EDGAR, M.D.,

Professor of Obstetrics and Clinical Midwifery in the Cornell University Medical College;
Visiting Obstetrician to the Emergency Hospital of Bellevue Hospital, New
York City; Surgeon to the Manhattan Maternity and Dispensary;
Consulting Obstetrician to the New York Maternity Hospital;
Fellow of New York Obstetrical Society; Fellow
of American Gynecological Society.

PREGNANCY, LABOR, AND THE PUERPERAL STATE.

THE DURATION OF UTERO-GESTATION.

In this connection four topics are of interest:

I. What is the normal period of utero-gestation? Protracted gestation.

II. The diminished duration of pregnancy, with the question of viability. Live birth.

III. Resemblances. Mother's marks.

IV. Substitution of children. Supposititious children.

So far as medical evidence concerns legitimacy, there are two important medico-legal questions for solution. These are:

I. The average duration of pregnancy and protracted gestation.

II. Diminished duration of pregnancy; premature delivery; period of viability; live birth.

I. AVERAGE DURATION OF PREGNANCY AND PROTRACTED GESTATION.

By the actual **duration** of pregnancy we understand the time that elapses between impregnation and labor. Owing to the fact that, as we shall show, a period of from one day to more than a week may elapse between insemination and impregnation, we are simply unable to estimate the exact date of conception.

Further, given a first and only cohabitation, it is impossible for any one to state positively whether or not the ovum subsequently impregnated (1) was discharged at the time of the last menstrual period, (2) is the product of an intermenstrual ovulation, or (3) is one corresponding to what would have been the next menstrual period had not the woman become pregnant.

"The **real duration** of pregnancy in the human female is accordingly an unknown quantity." [1]

We learn from experience, however, that the average apparent duration of pregnancy is ten lunar (nine calendar) months, or forty weeks, or two hundred and eighty days from the beginning of the last menstrual period, or two hundred and seventy-two days from the date of conception.

In the human subject, and even in the lower animals, the determination of the exact date of conception is by no means a simple matter. In woman it is only in very exceptional cases that the date of a fruitful sexual intercourse can be obtained.

Among the 5,010 women examined by Winckel[2] in reference to this point, but 1,700 or a little over one-third could give any information whatsoever. Even in those cases where impregnation follows the first and only coitus, certain physiological conditions render us liable to error.

Conception or impregnation is accomplished by the union of the male element—the spermatozoid—on the one hand, and the female element—the ovum—on the other; but we have no way of determining how long after the spermatozoids are deposited in the genital canal of the female their union with the ovum occurs. Pregnancy or gestation does not begin until such union is effected.

The ovum is discharged from the ovary during ovulation, and ovulation may or may not coincide with menstruation. The spermatozoa are deposited in the vaginal canal during sexual intercourse, and if there is no ovum in the canal above (uterus or Fallopian tube) ready to be impregnated, we have every reason to believe that the spermatozoa may remain in the genital organs of the woman, with sufficient vitality to impregnate the ovum when it does appear, for a limited period after coitus.

RELATION BETWEEN MENSTRUATION AND IMPREGNATION.

Milne Murray,[3] records a case in which insemination occurred a few hours before menstruation began and was followed by pregnancy and delivery two hundred and seventy-two days later. The menstrual period was perfectly normal and no subsequent coitus occurred. The interest in the case rests in the fact that the process of menstruation does not apparently interfere with the passage of the spermatozoa through the uterine cavity. Unless the spermatozoa travel much more rapidly than we at the present day believe they do, they must in this case have been caught in the menstrual flow, which began within two hours after they were thrown into the vagina. The spermatozoa must, therefore, have forced their way against the downward current of the menstrual blood, and have reached the Fallopian tube in good time to fertilize the discharged ovum.

---

[1] Jaggard: "Amer. System of Obstet.," vol. i. J. Veit: Zeitschr. f. Geb. u. Gyn., Bd. viii., p. 234.

[2] "Text-book of Midwifery," 1890, p. 94.

[3] Edinburgh Med. Journal, September, 1892.

Duncan says in this connection, that where a fertilizing insemination takes place just before the period is due, the latter frequently "does not take place at all, or only very scantily; the uterine system, as it were, anticipating the conception and preventing the failure which might result from a free discharge of blood."

It is quite evident that such cases occurring in married women would be very liable to be considered "cases of gestation protracted a month." In the case referred to in this article the period was a perfectly normal one, in no way differing from any of those that had immediately preceded it.

Bossi[1] states that from a series of observations on the wives of sailors, and the results of artificial impregnation, he is of the opinion that the most favorable time for impregnation is immediately following menstruation. He finds that the spermatozoa, contrary to the general supposition, retain their vitality in the vagina for at *least* seventeen days, even through a menstrual period.

B. Haussmann[2] found in the cervix of a woman, seven and a half days after the last cohabitation, spermatozoa that showed their vitality under the microscope by their movements.

Percy[3] found them eight and a half days after sexual intercourse.

They have been found with vitality eighty-two hours after death in criminals who have been executed; in the genital canal of bitches and rabbits, eight days after intercourse; and in the cow, six days.

---

[1] Nouvelles Archives d'Obstetrique et de Gynecologie, Paris, April, 1891.

[2] "Ueber das Verhalten der Samenfäden in den Geschlechtsorganen des Weibes," Berlin, 1879.

[3] American Med. Times, March 9th, 1861.

The spermatozoa are endowed with motion, and partly by their movements, partly by contractions and expansions of the cervix and uterus, as well as by capillary action, they ascend through the genital canal until the ovum is reached. As has been already stated, they may be in a condition to impregnate this ovum seven or more days after being deposited in the vagina.

So much for the male element. It will be readily seen that even in those exceedingly rare cases where there is but one cohabitation from which to date the commencement of pregnancy in order to compute its duration, we may be liable to error to the extent of at least one week. In other words, it may require one week or more for the spermatozoids to reach and fertilize the ovum.

Now let us turn to the female element—the ovum—and the question that first suggests itself to us is: When is the ovum liberated from the ovary?

We have no direct proof that sexual intercourse causes either the ripening or the discharge of the ovum, although there seems little doubt that the sexual orgasm may result in the bursting of a ripe Graafian follicle and the consequent entrance of an ovum into the Fallopian tube. Sexual congress may have this effect upon the discharge of an ovum from the ovary, but such congress is by no means necessary or essential for the liberation of the ovum, for it is quite certain that the discharge of the ovum occurs whether sexual intercourse has taken place or not.

The Graafian follicles burst and the ova are thrown off with more or less regularity during ovulation. Ovulation is generally believed to coincide with menstruation. We are in the habit of speaking of the phenomena of ovulation and menstruation as occurring at one and the same time. Because both of these processes are more or less rhythmic, because they occur at or about the same intervals, and are "more or less closely contemporaneous,"[1] scientists have come to believe "that one process depends on or is initiated by the other."[2]

Three theories are held:

(1) Menstruation excites ovulation;

---

[1] H. Newell Martin.

[2] *Op. cit.*

(2) Ovulation reflexly causes those changes or phenomena in the uterus called menstruation; or

(3) Finally, the two processes are absolutely independent, although they have certainly become associated.

Without going into the argument on either side, we may now accept the statement as a fact that menstruation and ovulation may occur entirely independent of one another. Women menstruate after the ovaries are removed, and on the other hand impregnation has occurred in women who have never presented any of the phenomena of menstruation, showing that ovulation must have occurred in the absence of menstruation.

From the foregoing it will be readily seen that a second difficulty stands in our way in calculating the commencement of gestation if—as we usually do—we date from a certain time marked by a menstrual period.

Enough has already been stated in this article for us to draw certain conclusions as to the uncertainty of calculating the exact duration of pregnancy:

1. Even where the date of the first and only cohabitation is definitely known, we are liable to error to the extent of at least one week, for we know that the spermatozoa may retain their vitality in the female genital organs for that time.

In this case either there is no free ovum in the genital canal or upon the surface of the ovary at the time of cohabitation; or, on the other hand, supposing there is a free ovum, a week or more may elapse before fertilization takes place. Here the usual number of days—272 to 275—added to the date of fruitful coition would leave us short by about a week.

2. Immediate impregnation may occur either by the fertilization of an ovum already free, or an acute sexual orgasm may result in the bursting of a Graafian follicle and the liberation of an ovum.

3. When we compute 280 days from the beginning of the last menstrual epoch as the duration of pregnancy, we lose sight of the fact that it is not always the ovum of this ovulation that becomes impregnated, but of that which would have been the next period, had not the woman become pregnant. In such an instance an *apparent* protraction of gestation to the extent of five weeks would be quite possible. Many so-

called cases of protracted gestation might be explained on this theory.[1]

His[2] examined sixteen embryos with the utmost care. He found that in twelve the stage of development proved that impregnation occurred, not at the time of the last, but at what would have been the next menstrual (first missed) epoch, had not the woman become pregnant. The remaining four embryos in their development corresponded to impregnation occurring at the last menstrual period.

Schlichting[3] investigated 456 cases and made the average to be 269.5 days, and yet the time varied from 240 to 334 days.

Winckel[4] gives us some of the most recent figures upon the subject. In his 5,010 cases examined he found 70 whose duration of gestation was more than 300 days, and 47 in whom the period was more than 302 days. He found further that in 6.8 per cent of those cases where the exact date of impregnation was known the duration was more than 300 days. In one case the duration was 314 and in another 318 days.

Krücke[5] reported a case where he believed the duration of pregnancy was 330 days.

A case is reported by Thomson,[6] in which gestation lasted 317 days from the last menstrual period, or 301 from the last sexual intercourse.

Loewenhardt,[7] from 518 cases in which the women could give the date of the successful coitus, found that the average duration of pregnancy from the date of conception was 272.2 days.

Leuckardt, in an analysis of 67 cases found upon the marriage-and-birth register of a church, in which labor occurred within ten months from the marriage night, computed the average duration of pregnancy to be 272.5 days.

Hasler,[8] from a large number of cases in which the date of impregnating coitus was known, estimated the average duration of pregnancy to be 272.24 days from the date of conception, and 280.5 days from the beginning of the last menstrual epoch.

---

[1] This theory, known as Sigismund's, has many followers.

[2] "Anatomie menschl. Embryonen," Abth. I., v. ii., Leipzig, 1882.

[3] Arch. f. Gynäk., Bd. xvi., 210.

[4] "Text-book of Midwifery," 1890, p. 94.

[5] Deutsche med. Zeitung, von Grosser, 1883, 370.

[6] Trans. London Obst. Soc., vol. xxvii.

[7] Archiv f. Gyn., iii., 1872.

[8] "Ueber die Dauer der Schwangerschaft," Zurich, 1876.

Recently Issmer,[1] in an exhaustive paper upon the duration of pregnancy based on a careful analysis of 464 cases, has made the following interesting points:

1. Conceptions occurring in the first half of the intermenstrual period are to those in the second half as 72 to 27.

2. Pregnancies dated from the first half of the intermenstrual period are shorter in duration than those dated from the second half.

3. When impregnation occurs in the first half, the ovum fertilized is that which has been discharged at the last menstruation (ovulation); while, when it occurs in the second half, the ovum impregnated is one that escapes at or near the next menstrual period.

4. The average duration of pregnancy is 268 days from conception, or 278 days from the completion of the last menstruation. Maximum duration, 304 days.

Among the lower animals the rule holds good that the smaller the animal the shorter is the duration of pregnancy. Here also we find variations. Thus the average duration is for—

the	rabbit,	30	days,	ranging	from	27 to 35	days
“	cat,	56	“				
“	bitch,	60	“				
“	sow,	120	“	“	“	109 to 138	days
“	sheep,	154	“	“	“	146 to 158	“
“	cow,	285	“	“	“	240 to 320	“
“	mare,	340	“	“	“	287 to 419	“
“	giraffe,	444	“				
“	elephant,	625	“				

In the human subject authorities differ somewhat in giving the average duration of gestation. Thus (calculated from first day of last menstruation)—

Schlichting[2] (440 cases), . .	gives	273.1	days
Matthews Duncan, ...	“	278	“
Löwenhardt[3]-Ahlfeld[4] (166 cases),	“	281.6	“

---

[1] Arch. f. Gyn., xxxv., 1889, p. 310.

[2] Archiv f. Gynäk., Bd. xvi., 210.

[3] *Ibid.*, Bd. iii., 456.

[4] Monat. f. Geburtsh., xxxiv., 180, S. 266.

Winckel[1] (5010 cases), . . .	gives 280	days
Issmer[2] (464 cases), . . .	" 278	"
Runge,[3]	" 280	"

All of these authorities found variations above and below the average of from 30 to 35 days.

How Long May Gestation be Protracted?

In Austria[4] the law recognizes the legitimacy of the child born within 240 to 307 days of the death of the father.

In France[5] "the legitimacy of the infant born 300 days after the dissolution of the marriage is liable to be contested."

In England and America[6] we find no absolute limit laid down. Each case is determined upon its merits. In America a liberal view is taken, and the legitimacy of births at the completion of 313 and 317 days respectively has been judicially decided. This limit of 317 days is, according to most medical authorities upon the subject, an extreme one.

The latest period to which pregnancy may be protracted is stated by various authorities as follows:

Depaul, ...	300 days	(high limit)
Robert Barnes, . .	300 "	(improbable)
Issmer,[7]	304 "	
Winckel,[8] . . .	320 "	
Schroeder,[9] . . .	320 "	
Schlichting,[10] . . .	334 "	
Runge,[11]	320 "	

Winckel gives as his reason for his investigations into the duration of pregnancy the following medico-legal case. He says:

---

[1] "Text-book of Midwifery," 1890, p. 94.

[2] Arch. f. Gyn., Bd. xvi., 210.

[3] "Lehrbuch der Geburtshülfe," Berlin, 1891.

[4] "Das k. k. Oesterreichische bürgerliche Gesetzbuch." "Amer. Sys Obstet.," vol. i.

[5] L'article 315 du Code civil.

[6] "The light of the courts in this matter is reflected light. Physicians must determine the matter; and if the space between the minimum and maximum periods hitherto allowed is shown to be too long or too short, the courts will readily follow the truth as it is made manifest." (Wharton "On Evidence," sec. 1,300.)

[7] Arch. f. Gyn., Bd. xvi., 210.

[8] "Text-book of Midwifery," 1890, p. 94.

[9] "Lehrb. der Geburtsh.," 9te Aufl., Bonn, 1886, p. 109.

[10] Arch. f. Gyn., Bd. xvi., 210.

[11] "Lehrb. d. Geburtshülfe," Berlin, 1891.

"I undertook these observations at the instigation of the legal authorities, in order to determine the possible duration of pregnancy, because a man already divorced from his first wife, by reason of her adultery, still sought her punishment by civil process. A new trial of the whole case showed the weight and length of the child, which had been born 310 days after the last cohabitation, to have been great, and the possibility that the duration may have been 310 days had to be acknowledged, and the woman was acquitted because the imputed adultery could not be proved by the supposed duration of the pregnancy and the appearance of the child."

Reese[1] states that it is possible for pregnancy to be prolonged beyond the usual period accepted as the average, but he gives no limit. He agrees with Taylor that we must "be prepared to admit either that conception may, in some cases, be delayed for so long a period as five to seven weeks after intercourse, or that there may be a difference of from five to seven weeks in the duration of pregnancy."

Schroeder[2] says: "I myself do not doubt for one moment that a mature child can be born within 240–320 days of the last period."

Winckel[3] makes the following concise statement: "The result of this discussion, therefore, as far as obstetrical and legal practice is concerned, may be summed up as follows: The average duration of pregnancy is about 280 days; it may vary, however, from 240 to 320 days, and perhaps even exceed this latter limit, which is by no means so rare as was formerly supposed; for in 6.8 per cent the duration is over 300 days."

ILLUSTRATIVE CASES OF PROLONGED PREGNANCY.

1. *Silberstein: Wien. Med. Presse, vol. xx.*, 1887, 29, *p.* 943.—Protracted pregnancies and over-development of the fœtuses in the same mother. Case I.—Duration of pregnancy was 308 days from last menstruation; child weighed ten pounds; was fully developed—hair, nails, etc. Case II.—Duration of pregnancy 313 days; child weighed nine pounds; still-born.

2. *Schlichting, Fr. X.: Archiv für Gynäk., xvi.*, 1880, *2d pt.*,

---

[1] "Text-book of Med. Jur. and Tox.," Phila., 1889.

[2] "Lehrb. der Geburtsh.," 9te Aufl., Bonn, 1886, p. 109.

[3] "Text-book of Midwifery," Phila., 1890, p. 94.

p. 203.—Statistics upon the onset of menstruation and on the length of pregnancy. Case of pregnancy which lasted 334 days; one that lasted 236; and another 205 days from last menstruation.

3. *Purkhauer, H.: Friedreich's Bl. f. gerichtl. Med.*, *Nuremb.*, 1890, *xli.*, 191–193; and *Medical Chronicle*, *Manchester*, *July*, 1891. —A case of protracted gestation. Woman was very small; twice a mother; age 26; menstruated regularly. Last menstruation April 28th, 1889. Quickening last part of September. Delivery expected February 5th; occurred March 13th. Motions of child not felt after December. Child born alive; weight 8 pounds 13 ounces; length 21¼ inches. Dating fecundation from May 5th, gestation was of 316 days' duration; dating it from May 21st (seven days before end of expected menstruation), it was 300 days; that is, 36 to 20 days longer than usual. Smallness of mother's parts was thought to prevent fœtal movements; absence of fœtal movements might explain delayed uterine contractions.

4. *Lutz, Chr.: Bayer. ärztl. Intell. Bl.*, *xxvi.*, 44, *p.* 475, 1879.—Dead child, born four weeks after usual time. Mother had had three other pregnancies protracted beyond 40th week.

5. *Jaffé, F.: Centralbl. d. Gynäk.*, *Leipzig*, 1890, *xiv.*, 74–76.—Multipara; æt. 31; labor occurred 365 days after last menstruation. Conception supposed to have occurred eight to nine weeks after last menstruation; woman was subject to such intervals of amenorrhœa. If this was so, then pregnancy had lasted 303–309 days.

6. *Hergott, A.: Bull. Acad. de Méd.*, *Paris*, 1889, *xxii.*, *pp.* 520–532.—Un cas de rétention fœtale. Fœtus died 45 days before operation. Absence of labor. Laparatomy on the 293d day of pregnancy, dated from last menstruation.

Conclusions:

1. Prolonged pregnancy is generally extra-uterine.
2. It is complicated with cancer.
3. Sometimes it is uncomplicated, as in the following cases:

(1.) *McBride:* Two cases. *Brit. Med. Jour.*, *vol. vi.*, 1886, *p.* 853.
(2.) *Cork: N. Y. Med. Jour.*, 1883, *p.* 249.
(3.) *Frank: Boston Med. and Surg. Jour.*, *Dec. 2d*, 1875.
(4.) *Hosmer: Boston Med. and Surg. Jour.*, 1881.
(5.) *Lee: Brit. Med. Jour.*, *April 22d*, 1876.
(6.) *McDonald: Brit. Med. Jour.*, 1883, *p.* 13.
(7.) *Thomson: Lond. Obst. Trans.*, *vol. xxvii.*, 1885, *p.* 309.
(8.) *Woodhouse: Dubl. Med. Jour.*, 1882, *p.* 13.
(9.) *Young: Edinb. Med. Jour.*, *March*, 1864.
(10.) *Nunez: Amer. Jour. Obstet.*, 1886, *vol. xviii.*

7. *Casey, R. J.: Lancet*, *London*, 1873, *i.*, 293.—Case of pregnancy protracted to 350th day.

8. *Bryon, J. D.: St. Louis Med. and Surg. Jour.*, 1877, *xiv.*, 345–346.—Gestation prolonged to 342 days.

9. *McTavish, D. A.: N. Y. Med. Jour.*, 1889, *xliv.*, 413.—Case of pregnancy prolonged to 318 days.

10. *Mans, L. M.: N. Y. Med. Jour.*, 1889, *xlix.*, 519.—Remarks on prolonged gestation in the human female, with notes of a case extending over a period of 334 days.

11. *Graves, T. T.: Boston Med. and Surg. Jour.*, 1876, *xciv.*, 353. —A case of gestation extending to 306 days.

12. *Jefferis, D. W.: Trans. Med. Soc. Pa., Phila.*, 1879, *xii.*, 759.—A case of prolonged gestation ; 358 days from the cessation of the menses to the delivery of the child.

13. *Henderson: Amer. Jour. Obstet.*, N. Y., 1879, *xii.*, 393–400.—Case of gestation prolonged to 15 months. Discussion.

14. *Renouf vs. Eden.*—(See *Med. Times and Gazette*, 1870, *i.*, *p.* 290. Queen's Bench, Feb., 1870.) See Tidy, "Legal Medicine," "Action for Seduction." A child was born 307 days (or 44 weeks, minus one day) after the possibility of intercourse occurring between the parties. Verdict for the plaintiff. The case, however, was not decided upon the medical evidence, but on the ground that the plaintiff was entitled to damages, because he (defendant?) had induced the child to leave her mother's roof and had then seduced her."

15. *Duncan: Med. Times and Gazette, Dec. 29th*, 1877, *p.* 712.—(Quoted by Tidy.) "A case of pregnancy lasting 325 clear days, reckoned from the last day of menstruation. The woman's bulk when confined was enormous, and the child of more than usual size and weight. In three previous pregnancies it was said that she had carried the children 300 days in one case and 285 days in the other two cases."

16. *Gardner Peerage Case.*—Abstract of the cases before the House of Lords (Taylor's "Med. Jur.," Vol. II., p. 267). See also for more exhaustive accounts Beck's "Med. Jur. ;" Tidy on "Legal Medicine ;" Montgomery: "Signs and Symptoms of Pregnancy."

"Allan Legge Gardner, the son of Lord Gardner by his second wife, petitioned to have his name inscribed as a peer on the Parliament roll. The peerage was, however, claimed by another person, Henry Fenton Jades, who alleged that he was the son of Lord Gardner by his first and subsequently divorced wife. It was contended that the latter was illegitimate ; and in order to establish this point the evidence adduced was partly medical and partly moral.

"Lady Gardner, the mother of the alleged illegitimate child, parted from her husband on board of his ship on the 30th of January, 1802. Lord Gardner went to the West Indies, and did not again see his wife until the 11th of July following. The child whose legitimacy was disputed was born on the 8th of December of that year. Therefore, the plain medical question, taking the extreme view, was whether a child born 311 days (forty-four weeks and three days) after intercourse (from January to December), or 150 days (twenty-one weeks and three days) from July to December, could be considered to be the child of Lord Gardner. If these questions were answered in the affirmative, then it followed that this must have been a very premature or a very protracted birth.

"There was no pretence that this was a premature case, the child having been mature when born. The question then was reduced to this: Was this alleged protracted gestation consistent with medical experience?

"Many medical witnesses, comprising the principal obstetric practitioners in the kingdom, were examined on this point. Their evidence was very conflicting, but a large majority concurred in the opinion that natural gestation might be protracted to a period which would cover the birth of the alleged illegitimate child.

"On the moral side of the question it was clearly proved that Lady Gardner, after the departure of her husband, was living in open adulterous intercourse with a Mr. Jades; and on this ground Lord Gardner obtained a divorce from her after his return. It was contended that the counter-claimant was really the son of Lady Gardner by Mr. Jades. The decision of the house was that this claimant was illegitimate, and that the title should descend to the son of the second Lady Gardner."

17. *Corn vs. McCarty*, 2 *Clark* (*Pa.*), 356.—In this case the court said: "The organs of conception, like those of digestion, perform their appropriate offices without the volition of the female. She is not conscious at the moment of the occurrence of what has taken place. It is only by inference that she can fix the paternity of her offspring."

18. *Kilpatrick*, *A. R.: South. Med. Record*, *Atlanta*, 1875, *v.*, 338. Case of a dead fœtus retained in utero over four months; and cases of prolonged pregnancy.

19. *Cosentino*, *G.: Sicilia Med.*, *Palermo*, 1889, *i.*, 30–41.—"Distocia per gravidanza diuturna." In this article three cases of alleged protracted gestation are recorded which caused difficult labor on account of the size of the children. Counting from the date of the commencement of the last menstruation the durations of pregnancy were respectively 311, 300, 287 days; the weight of the fœtuses was respectively 10, 15, 12 pounds.

20. *Ingleby*, *Mackenzie: British Gyn. Jour.*, *London*, *Feb.*, 1890. —The woman was 32 years old, a primipara, married ten years, and had always menstruated regularly. The last menstruation before her confinement occurred April 28th. Fœtal movements were felt by her in September. False pains occurred in January. On March 8th, after a labor of sixty-six hours, she was delivered, her pregnancy having thus continued 314 days.

21. *Jaffé: Centralblatt für Gynäkologie*, *No.* 5, 1890.—A case of a multipara, in whom gestation lasted between 300 and 309 days.

The development and measurements of the child corresponded to the prolonged gestation.

22. *James P. Baker, Esq.*, of Indianapolis, cites the following in *Parvin's* "*Text-Book of Obstetrics*" (Philadelphia, 1886):

"Judges, like doctors, are liable to differ, and the decisions of courts have not been entirely harmonious as to the period of gestation. In the case of O'Brian *v.* the State *ex rel.* Swift, 14 Ind., 469, the Supreme Court of Indiana say:

"'Those who have investigated the subject, know that in the course of nature, a child living and capable of surviving to the ordinary age of man, may be born in seven, and may not be born until the expiration of ten, months from the cessation of the catamenia indicating the time of its conception.'

"The case of Duck *v.* The State *ex rel.* Dill, 17 Ind., 210, was a prosecution for bastardy. In such a case, the question always is: 'Is the defendant the father of the child?' Any evidence tending to show that any other man is the father is admissible. The child was born on September the 18th, 1858. On the trial the defendant offered to prove that the relatrix had had sexual intercourse with another person in the first week of November, 1857. The evidence was rejected. The Supreme Court held that this evidence was rightly rejected, and said:

"'It is true, experience proves that the period of gestation is almost as variable in individual cases, though within narrow limits, as that of the length of human life; but the longest period we have ever known to be judicially allowed was 313 days. See the case of Commonwealth *v.* Hoover, 3 Clark, Pa., 514. In the case at bar, the evidence might have covered a period of 322 days.'

"A still longer time was judicially allowed, however, in the case of the United States *v.* Collins, tried in the United States District Court for the District of Columbia, in 1809, and reported in Cranch's Circuit Court Reports, Vol. I., p. 592. The case was an indictment for not supporting a bastard child. The mother was received as a witness. The attorney for the government objected to the cross-examination as to her connection with other men than the defendant. The Court overruled the objection, but limited the time of inquiry to a period of not more than twelve months nor less than six months before the birth of the child. This is an extreme case. In Paul *v.* Padleford, 16 Gray (Mass.), 263, a bastardy prosecution, the Court refused to allow proof of acts of intercourse of the plaintiff with other persons than the defendant, at a time more than ten months and twelve days before the birth of the child. In Phillips *v.* Allen, 22 Allen (Mass.), 453, the Court said:

"'The child was born in eight months after the marriage, and the fact that a child is born thus soon after the husband had first access to the wife, does not prove beyond all reasonable doubt that the child is not his. There are ancient decisions that gestation somewhat more than nine months after the husband could have had access to the wife, does not disprove the legitimacy of the child. See Hargrave's note to "Coke's Litt.," 123 *b*, where these decisions are cited, and where in support of them the testimony of Dr. Hunter is introduced, expressing his opinion that gestation often varies from one to three weeks from nine calendar months, and that children are sometimes born in seven months from conception, and live and grow to manhood.'

"In Eddy *v.* Gray, 4 Allen (Mass.), 427, which was a bastardy prosecution, the Court below had admitted testimony tending to show illicit intercourse by the complainant with other men than the defendant at a period of time more than ten months before the birth of the child. The Court said:

"'Such testimony, in the absence of proof that the period of gestation extended beyond the usual duration, according to the common and natural course of life, which is recognized as well by legal as medical authorities, is inadmissible, and should have been excluded. See Co. Litt., 123 *b*, and note by Hargrave.'

"In the recent case of Ronan *v.* Dugan, 126 Mass., *p.* 176, a prosecution in bastardy, the Supreme Court of Massachusetts say:

"'In cases of this kind, the admissibility of evidence of illicit intercourse of the complainant with any other man than the defendant, depends upon the relation to the time when the child was born. In Eddy *v.* Gray, 4 Allen, 435, where the intercourse offered to be proved occurred more than ten months before the birth, the evidence was held to be inadmissible, without proof that the period of gestation was prolonged beyond the usual duration. We see no reason why the same rule should not be followed where the intercourse offered to be proved took place less than seven months before the birth, in the absence of the proof that the birth was premature.'

"In such a case the Tennessee Code limits the inquiry between the first of the tenth and the first of the sixth month next before the birth of the child. See Crawford *v.* The State, 7 Baxter, 41."

II. DIMINISHED DURATION OF PREGNANCY.—VIABILITY.—LIVE BIRTH.

An interesting question touching upon legitimacy is the possibility of a diminished period of gestation. The question for solution is: Can what is known as a fully developed child be born before the termination of the usual period of pregnancy, and how long before?

A husband and wife are for some reason separated for a long period of time—say two years. They are reunited and after a period of seven months, or perhaps a little more, an apparently fully developed child is born. Is this child legitimate?

Such cases as these are sometimes termed **precocious births**.

Medical literature contains numerous instances of women who habitually give birth to children at the seventh month, and yet we have no reason to believe that these children have any of the characteristics of the fully developed child. In these cases undoubtedly some pathological condition is the cause of the premature emptying of the uterus.

There seems to be no doubt that children at full term may differ as to length, weight, and other characteristics. We see an eight-months' child sometimes apparently better developed than another born at nine months. This is not the rule but the exception.

Hodge and Spiegelberg both taught that strong and vigorous children might be delivered before the completion of the nine months of gestation. It is the belief of the writer that, in a given case, where pregnancy has continued to within two or three (or possibly four) weeks of its completion, there may be some doubt whether the child born at that time be a full-term one or not, on account of the advanced stage of its development.

"In an English case, where the question of the legitimacy of a child was made to depend upon the period of the mother's gestation—259 days or 37 weeks (or three weeks lacking maturity), Sir J. Simpson gave evidence that a child born perfectly matured, three weeks before the usual term, could not be legitimate. This is certainly stronger ground than we would venture to take. To bastardize a child, and to impute the crime of adultery to the mother, because of the three weeks' prematureness of the birth, even though apparently mature, is, we think, an assumption not warranted by numerous facts" (Reese).[1]

There is no single characteristic or sign about a child recently born that will enable us to state positively how long the fœtus remained within the uterus. There are, however, a number of signs and characteristics which, taken collectively, enable us to state approximately the duration of intra-uterine life (see page 291).

---

[1] "Med. Jurisp. and Toxicol.," Phila., 1889.

VIABILITY OF CHILDREN BORN BEFORE TERM.

By the viability of a child we mean its capability of surviving. Medical authorities generally do not consider a child "viable" until it has reached the completion of the twenty-eighth week or the seventh lunar month of intra-uterine gestation. Seven and eight months' children may readily survive. Children born before the completion of the seventh lunar month may live a few hours or even days, but usually perish because their organs are not in a sufficiently advanced condition of development to support life. There are numerous instances, however, attested to both by the appearances of the children and the statements of the mother regarding the date of impregnation, where children of a less age than twenty-eight weeks have survived.[1]

Considerable difficulty has attended and always will attend the establishment of the exact date of impregnation, and as a consequence the same difficulty prevents us from determining the exact age of a child prematurely delivered (see Duration of Pregnancy).

"A very few exceptional cases have been recorded of the survival of children born a little over five months. An infant born earlier than this period could not be considered viable" (Reese).

Until recently it was generally believed that a child born as the result of a miscarriage at the end of the sixth month would almost of necessity die within a very short time of birth. Budin,[2] however, by means of Tarnier's *couveuse* and the operation of artificial feeding known as *gavage*, has lowered the mortality to a wonderful degree. By these means at the Maternité in Paris children have been saved—

At six months, . . .	30.0 per cent
At seven months, . . .	63.6 "
At eight months, . . .	85.7 "

"Of the children born at seven to eight and a half months, only 33 per cent are actually kept alive" (Winckel).

---

[1] Ahlfeld: Arch. f. Gyn., viii., 194.

[2] La Semaine médicale.

To what Extent may the Normal Period of Utero-Gestation be Shortened, and Birth Notwithstanding be Given to a Living Child ? (Viability.) In answer to this question, Tidy[1] states: "The question involves matters of grave importance, affecting not only the legitimacy of children but the honor of parents, and sometimes even the interests of nationalities.

"The earliest actual period at which a child is viable—that is, capable of extra-uterine life—must be determined by careful study not only of the cases generally reported but more particularly of those when no possible object was to be served by untruthfulness or confusion of facts; and such cases are admittedly very rare.

"In all questions of this nature, the two points requiring the special consideration of the medical jurist are as follows:

"1. Is a child of the age stated, or estimated, viable? That is, not whether it be mature or immature, nor whether it be diseased or healthful, nor whether it be likely or unlikely to be reared, but—was the child of such an age as to be capable of showing some indication of live birth after it was completely external to the mother?

"Such an inquiry will be of importance in cases of tenancy by courtesy. The question whether these like indications were exhibited before or after the separation of the cord, is for legal purposes immaterial.

"2. Granting it to be alive when born, is it probable that a child of the age stated or estimated could be reared?

"This question may be of importance in certain cases involving legal rights, as, *e.g.*, when a child is born shortly after marriage. In the tabular statement under the heading of Case 84[2] will be found the chief recorded cases where children have been born alive at early periods of utero-gestation. It may be here mentioned that the Parliament of Paris, in the case of Cardinal Richelieu, decided 'that an infant at five months possessed that capability of living to the ordinary period of human existence, which the law of France required for establishing its title to inheritance.'

"The Code Napoleon, however, mentions 180 days, or six calendar months, as the earliest period of utero-gestation when a child may be live-born. The Scotch law allows an infant to be viable at six lunar months, or 168 days. The practical conclusions to be drawn from the large number of recorded cases of abnormally shortened utero-gestation are as follows:

---

[1] "Legal Medicine," New York, 1884, vol. iii., p. 31.

[2] Refers to illustrative case in Tidy's "Med. Jurisprudence."

"1. Allowing that from the first moment of impregnation the ovum is truly alive; and, further, that mere motion of the limbs, or evidence of circulation, without active respiration, are sufficient to constitute live birth, nevertheless there is no evidence to show that a fœtus, born at an earlier period than between the fourth and fifth months of uterine existence, can in any sense be said to be born alive, much less lead an independent life, *i.e.*, a life apart from its mother.

"2. That living children have been born between the fourth and fifth months of uterine life. As a rule, however, the only sign of life exhibited by children born at this early period is a slight motion of the limbs, although cases of somewhat more active vitality have been recorded. There is, however, no well-authenticated case where a less than five-months child has lived beyond twenty-four hours after its birth, and but one where it has lived for twenty-four hours.

"3. That children born alive at the fifth or between the fifth and sixth months of utero-gestation, mostly die after a few hours (Case 90).

"Nevertheless, there are a limited number of recorded cases, where such children have been reared and have even reached adult age (Case 84—13, 19, etc.). Thus in two out of the three illustrative cases recorded, in one the child born on the 174th day—calculated from the date of marriage—lived for seven months, the court deciding against the accusation of incontinency (Case 86), while in the second where the child reached maturity, there was an interval of 182 days only between its birth and the birth of the previous child (Case 88). In this latter case, assuming the prolific coitus to have taken place fourteen days after the first confinement, the uterine age of the child could not have exceeded 168 days. The question arises, however, whether the child may not have been a product of superfœtation (see Superfœtation). At any rate, this is not so in Case 86, where the time was estimated from the day of marriage, the good character of the parents being admitted by the court (Case 87).

"4. That several well-authenticated cases exist where children were born between the sixth and seventh months, and even at the sixth month have reached adult age, but that in such cases more than ordinary care and attention have been needed to maintain life, at least for some time after birth.

"Dr. Bonner ('A Critical Inquiry regarding Superfœtation, with Cases,' 1865) has collected eleven cases where children born about the 180th day of utero-gestation survived their birth for periods varying between eight days and fifteen years.

"5. That in all cases of early birth beyond the facts indicated by well-authenticated records, the question of the character of the parents, the conditions of the accouchement (such as its concealment and certain other general considerations) must of necessity constitute important evidence on which a jury should rely to decide the question of legitimacy.

"To the medical jurist the sound words of advice and warning of a learned obstetrician may not be out of place.

"'Take care not to be deceived. I have known many cases of fully developed and mature children being born within seven months of marriage. They are commonly regarded as marvels limited to first pregnancies. In all cases where legitimacy is contested on the ground of shortened utero-gestation there is one most pertinent question that the medical jurist will be called upon to answer and that is—Did the appearances presented by the child at birth correspond or not with its alleged shortened term of uterine life? It is unfortunate that, as a rule, discussions respecting the legitimacy of children occur after they are grown up, when it becomes necessary to rely for evidence on the memory of the accoucheur, or of the nurse in attendance, as to their condition and precise state of development at the time of birth. It is, however, certain—

"*a.* That although a child born at full time may vary in size, weight, and the like, nevertheless that it always has about it the general signs of what is called 'development:' that is, full maturity.

"*b.* Nevertheless, it must be admitted that it would be difficult, in the majority of cases, to decide with unerring precision whether a child at birth was an eight-months or nine-months child.

"*c.* It is, however, scarcely possible to suppose that a fully developed child could be mistaken for a seven-months child, it being a generally accepted fact, that the changes the fœtus undergoes during the last two months of uterine life are more marked than those occurring during any other period. Nevertheless, seeing that exceptional cases occur where children born at full term are enormously in excess of average size and weight, it is manifest that the medical jurist would scarcely be justified in pronouncing a positive opinion that a seven-months child might not be as well developed as an eight or nine months child under ordinary circumstances.

"*d.* That supposing a child be born mature and fully developed, and further supposing it proved that to be the child of a husband it could not be more than a six-months child, the medical jurist need have no hesitation in pronouncing it illegitimate.

"Here then two questions suggest themselves:

"1. What are the signs of maturity in a new-born child? (See p. 284.)

"2. What are the indications whereby the development of the fœtus may be ascertained?" (See p. 291.)

Live Birth.

What Constitutes Live Birth ?—Sometimes it becomes necessary to establish the fact that the child when born was alive, independent of its viability, *i.e.*, capability of continuing to live. The question to be decided in such cases is not whether the child was mature, immature, or viable, but simply, **Was it alive?**

The test of a live birth differs in various countries.

In Germany[1] crying "attested by unimpeachable witnesses;" in France, respiration; in Scotland, crying. In England and the United States, "neither breathing nor crying are essential to establish a live birth; the pulsation of the child's heart, or of one of its arteries, or the slightest voluntary movement is regarded as sufficient for this purpose" (Reese).

In regard to crying as a test of live birth Coke remarks: "If it be born alive, it is sufficient, though it be not heard to cry, for peradventure it may be born dumb."

Legally all we require for a live birth is anything to prove that the child was alive at the time when it entered the world. Whether the child was viable or not does not enter into the definition.

---

[1] Reese.

Two cases in particular are usually cited to show that fœtuses have been born alive before the completion of the fifth month of intra-uterine gestation and even as early as the end of the fourth month. One is that of Dr. Barrows of Hartford, and the other of Dr. Erbkam of Berlin.

In Dr. Barrows' case[1] a point of especial interest is the fact that the date of apparent impregnation was fixed.

This woman miscarried on the 18th of May. Following this miscarriage there was a profuse and prolonged lochial discharge. Upon the 18th of June there was a marked increase in the vaginal discharge, which was taken to be a menstrual period. This continued over a week and then entirely ceased. On June 27th the woman left her home to make a visit in the country, and then experienced sexual intercourse for the first time subsequent to her miscarriage. On the 18th of November, as a result of severe physical exertion, another miscarriage occurred, Dr. Barrows still being her attending physician. The ovum was expelled intact. The amount of liquor amnii was estimated to be about two pints.

"The membranes were not ruptured for some little time, during which the movements of the child were active and vigorous. On rupturing the membranes and exposing the child to the air, it instantly gasped, or, perhaps I ought rather to say, uttered a cry so loud as to be heard distinctly at a distance of several feet, it being at the same time covered with the bedclothes. The cord was tied on its ceasing to pulsate, at the end of two or three minutes, then separated, and the child wrapped in warm flannels. As it continued to manifest the ordinary appearances of life, its condition was watched with much interest and care. It breathed with a kind of convulsive gasp at intervals of one or two minutes, for a period of forty minutes. The heart beat regularly for forty-five minutes. . . . The child repeatedly opened its mouth, and thrust forward its tongue."

The fœtus, a female, measured ten inches, and the weight was fourteen ounces. In spite of the fact that the frontal and parietal bones were imperfect, the head was quite firm, and

[1] Amer. Jour. Med. Sciences, April, 1853, p. 380.

covered with a down-like hair. A firm skin covered the body, of a light color, with the exception of the abdomen, where it was reddish and thin. Rudimentary nails could be seen and the membrana pupillaris entirely closed the iris.

If we place the date of impregnation as corresponding with the date of the first cohabitation following the first-mentioned miscarriage, then we would have as the duration of the pregnancy and the age of the child 144 days, or less than five calendar months by six days.

Although the weight of this fœtus, fourteen ounces, is somewhat in excess of the average weight at the completion of five months of intra-uterine life, yet the length, which is of far greater value as a reliable sign of the duration of pregnancy, would indicate that the fœtus was not quite five months old. The remaining characteristics of the fœtus, as well as the date of the supposed conception as stated by the woman, all agree with the estimated 144 days as the length of gestation.

In Dr. Erbkam's[1] case the fœtus measured six inches in length and weighed eight ounces. It was born alive and lived half an hour; it moved its extremities, turned its head from side to side, and opened its mouth. Müller, who saw this fœtus, stated that it was not more than four months old.

THE CHARACTERISTICS OF THE FULLY DEVELOPED (FULL-TERM, MATURE) CHILD.

1. **Length.**—According to Winckel and others, the length of the child is the most reliable test of time the fœtus has remained within the uterus. Second in importance stands the weight, and third the diameters of the head.

The following table is taken from Quetelet's "Anthropométrie" (Brussels, 1870), and gives the average lengths of a large number of Belgians, which are probably somewhat less than the average for a corresponding number of English would be:

LENGTH OF THE NEW-BORN CHILD.

	MALES.		FEMALES.	
Maximum	20.97 in.	53.3 centimetres.	21.87 in.	55.4 centimetres.
Average	19.72 "	50.1 "	19.34 "	49.1 "
Minimum	17.24 "	43.8 "	17.24 "	43.8 "

---

[1] Amer. Jour. Med. Sciences, 1838, p. 244.

Winckel[1] from observations of several thousand cases gives the following figures:

Maximum = 21.80 inches = 55.4 centimetres
Average = 20.00 " = 50.8 "
Minimum = 19.20 " = 48.8 "

The following table is taken from Tidy:[2]

Average length of 247 mature children (both sexes) = $18\frac{4}{5}$ in.
" " 130 " " (males) = $19\frac{5}{8}$ "
" " 117 " " (females) = $18\frac{5}{8}$ "
Maximum = 22 inches.
Minimum = 16 inches.

Dr. Delahost, of Rouen, says that the length of the fœtus for the first six months is indicated in centimetres by the square of the number of the corresponding month. That at one month the fœtus measures one centimetre, at two months four centimetres, and so on. During the last three months the monthly rate of growth is four or five centimetres.

Taylor gives 16 to 21 inches for the average length.

Tardieu's averages are 18 to 20 inches.

Lusk gives the average length as from 20 to 21 inches.

2. **Weight.**—It must be borne in mind that the weight of the child is dependent upon race, sex, stature of parents, and perhaps to a certain extent upon the age of the mother.

AVERAGE WEIGHT.

Hecker,[3] in Munich (1,000 births), $6\frac{4}{5}$ lbs. average.

Fesser,[4] in Breslau, $6\frac{1}{2}$ lbs. average.

Ingerslev,[5] in Copenhagen (3,450 births), about 7 lbs. average.

Scanzoni[6] in Vienna (9,000 births), about 7 lbs.

Besides giving the above figures, Lusk[7] states his own observations upon 200 children born in the Bellevue Hospital. For these the average was $7\frac{3}{4}$ lbs. for both sexes. The boys averaged $7\frac{9}{10}$ lbs. and the girls $7\frac{1}{3}$ lbs.

---

[1] "Text-book of Midwifery," 1890, p. 51.

[2] "Legal Medicine," vol. iii., p. 33, Wm. Wood & Co., New York.

[3] "Klinik der Geburtskunde," ii., 1864.

[4] Spiegelberg, "Lehrbuch," p. 86.

[5] Obstet. Journ., iii., 1876, p. 705.

[6] "Lehrbuch der Geburtshülfe," p. 96.

[7] "Science and Art of Midwifery," New York, 1892.

"Three-fourths of the mothers were of Irish birth, one-fifth were born in America, while the remaining fraction was divided between English, Scotch, and Germans. The largest child weighed eleven pounds."

Quetelet also gives the average weight at birth as 6.8 lbs. for boys, and 6.6 lbs. for girls; Taylor, 5 to 9 lbs. for the average weight of mature children; Tardieu, 6 to 7 lbs.

Of 4,104 infants born at the Maternité, Madame Alliott found that 2,142 weighed between 6.6 and 7.7 lbs. (Tidy).

Winckel's figures for the weight of the fully developed child are 5.3 lbs. for the minimum and 10.5 lbs. for the maximum. Of 3,000 children born in Munich, he states, from 1884 to 1886, only 46 or 2.3 per cent weighed 7.8 lbs. or more, and none weighed over 9.7 lbs.

Pinard, from an examination of the records of the Paris University, found that but one in 20,000 cases weighed a trifle over twelve pounds.

Dr. R. P. Harris, in a note of Playfair's "Midwifery," states: "We have had children born in this city, Philadelphia, at maturity that weighed but one pound. The well-remembered 'Pincus' baby weighed a pound and an ounce."

"Probably the largest fœtus on record was that of Mrs. Captain Bates, the Nova Scotia giantess, a woman 7 feet 7 inches in height. This child, born in Ohio, was their second, and was lost in its birth, as no forceps of sufficient size to grasp the head could be procured. The fœtus weighed twenty-eight and three-fourths pounds, and was thirty-nine inches in length. Their first infant weighed nineteen pounds."

There is a popular belief that long and heavy children have been retained in the uterus longer than usual.

As a general rule, still-born children are heavier and longer than those born alive, males than females, single children (*cæteris paribus*) than twins, and twins than triplets (Tidy).

In 500 male and 500 female children, taken from the records of the Philadelphia Hospital, the average weight at birth of the female was seven pounds one ounce and a half, and of the male seven pounds eight ounces. In only one of a thousand was the weight eleven pounds (Parvin).[1]

---

[1] "A curious fact which I observed in my hospital service is, that there is less difference in weight between the sexes of the new-born in the

3. **Diameters of the Fœtal Head and Body at Term.**—Lusk[1] bases his table of measurements upon that given by Tarnier and Chantreuil, and gives the following figures:

DIAMETERS OF THE FŒTAL HEAD.

Occipito-mental diameter, 5¼ inches.
Occipito-frontal diameter, 4½ inches.
Suboccipito-bregmatic diameter, 3¾ inches.
Biparietal diameter, 3¾ inches.
Bitemporal diameter, 3¼ inches.
Bimastoid diameter, 3 inches.
Fronto-mental diameter, 3¼ inches.
Cervico-bregmatic diameter, 3¾ inches.
Great circumference (occipito-mental), 14¾ inches.
Small circumference (suboccipito-bregmatic), 13 inches.

Spiegelberg[2] gives the breadth of the shoulders, the bisacromial diameter, as about 4¾ inches, and the circumference corresponding to this diameter as 13½ inches. He further gives the dorso-sternal diameter as from 3½ to 3¾ inches, and the bisiliac 3¾ to 4 inches.

4. **The Color of the Skin.**—In the mature child the color of the skin is pale red, much paler than in the case of the immature child, where we see a deep or dark red color more often.

5. **Hair upon the Head.**—The hair is generally thick, and from one to two inches in length (Winckel).

6. **Immobility of the Cranial Bones.**—The sutures and fontanelles should be narrow, and the length of the anterior fontanelle should be from three-fourths to one inch in length, and the cranial bones are not especially movable (Casper). The bones of the head are hard and their margins lie close to one another (narrow sutures).[3]

7. **Lanugo—Vernix Caseosa—Sebaceous Cysts.**—Lanugo, or the fine short down, which almost entirely covers the surface of the immature child, disappears to a great extent

---

black than in the white. While a sufficient number of observations have not been made to establish a law, there are *a priori* reasons for believing in the possibility of such a law" (Parvin: "Science and Art of Obstetrics," Phila., 1886, p. 138, note).

[1] "Science and Art of Midwifery," New York, 1892.

[2] Spiegelberg: "Lehrbuch der Geburts.," 1891, p. 97.

[3] *Ibid.*, 1891.

as maturity approaches and is only seen upon the neck, shoulders, and back.

Vernix caseosa is usually found in the folds of the thigh, back, and axilla, but may be extensive in amount.

The statement is made, that certain white spots, found in many cases on the cheeks, forehead, alæ of the nose, and especially upon the chin and lower lip, and which are said to be formed by the dilatation of the excretory ducts of the sebaceous follicles, are abundant in proportion to the immaturity of the fœtus, decreasing in number as full term approaches. At full term they are only to be found on the tip of the nose (Küstner).[1]

MECONIUM.[2]—At full term meconium, which consists of intestinal mucus and epithelia, swallowed liquor amnii (epithelial shreds, lanugo, and vernix caseosa), and which is of a dark color, owing to the presence of cholesterin and bilirubin crystals, is now only found in the rectum.

8. **Conditions of the Nails.**—On the fingers they should extend beyond the tips; on the toes only as far as the end.

9. **Position of the Umbilical Cord.**—Many authorities state that the insertion of the cord is in the centre of the body in a mature child. Tidy[3] states that "the exceptions to this rule are . . . so numerous as to deprive it of any forensic value as a sign of maturity." Winckel[4] places it one to one and a quarter inch under the exact middle point of the body. Spiegelberg[5] puts it just below the middle of the long axis of the body, and quotes Hecker as stating that even at the sixth or seventh month the distance from the symphysis to the ring is to that from the ring to the ensiform cartilage as 1:1.6.

10. **Condition of the Genitals.**—They should be fully developed. In the mature male the testicles are usually[6] present in the scrotum, which is markedly corrugated and brownish; the canal is still open, however.

In the mature female the labia majora touch one another and usually, but not always, completely cover the labia minora,[7] ostium vaginæ, and clitoris. The latter is no longer prominent as in immature children. Exceptions to the foregoing are not uncommon.

---

[1] See London Med. Rec., November 15th, 1870, p. 461, and Arch. f. Gynäk., Berlin, 1877, xii., 102–113.

[2] Zweifel: Arch. f. Gyn., vii., p. 474. Spiegelberg: "Lehrbuch der Geburts.," 1891, p. 97.

[3] "Legal Medicine," Wm. Wood & Co., New York, vol. iii., p. 36.

[4] "Text-book of Midwifery," 1890.

[5] Spiegelberg: "Lehrbuch der Geburtshilfe," 1891.

[6] Tidy found but one testicle at birth in three or four per cent.

[7] Spiegelberg: "Lehrbuch der Geburtsh.," 1891, p. 197.

11. **Condition of the Cartilages of the Ears and Nose.**—In mature children the cartilages of the ears and nose should be distinctly perceptible.

12. **The Centre of Ossification in the Lower Epiphysis of the Femur.**—This test, of course, can only be applied where the child is dead. At one time it was held "that, in the second half of the tenth (lunar) month, the centre of ossification of the inferior femoral epiphysis makes its appearance" (Béclard, Ollivier, Wildner).[1]

The centre of ossification in the lower epiphysis of the femur is usually one-fifth of an inch in size in the mature fœtus; "but may attain to this at an earlier period, and may also be wanting or very little developed at birth" (Caspar, Béclard, Hecker, Hartmann).[2] (Plate III, Fig. 7.)

Spiegelberg[3] states that the bone nucleus in the lower epiphysis of the femur is about one-fifth of an inch long at full term, but that it may be much smaller or even be absent.

Tidy[4] gives the following directions for finding the centre of ossification: "To find this centre of ossification, a horizontal incision is to be made through the skin and superficial tissues over the knee-joint down to the cartilages. After removing the patella, the end of the femur is to be made to protrude. Horizontal sections are now to be carefully sliced off from the cartilaginous epiphysis, layer by layer, until a colored point is observed, the greatest diameter of which osseous nucleus is to be measured. This nucleus appears to the naked eye as a more or less circular blood-red spot in the midst of milk-white cartilage, in which vascular convolutions may be distinctly recognized."

In Caspar's observations upon this osseous nucleus the results were as follows:

	Number of Children Observed.	Size of Nucleus.
In the 7th and 8th month....	31	0
In the 9th and 8th month....	9	0–2 lines.
In mature children..........	52	$\frac{3}{4}$–4 "

---

[1] Tidy.

[2] Winckel.

[3] Spiegelberg: "Lehrbuch der Geburtsh.," 1891, p. 51.

[4] "Legal Medicine," W. Wood & Co., 1884, vol. iii., p. 36.

Ollivier d'Angers measured the nucleus in the case of fifty infants varying in age from a few hours to one year, and his results were as follows:

At term from $\frac{1}{25}$ to $\frac{2}{25} \times \frac{1}{6}$ or $\frac{1}{5}$ of an inch.
13 to 20 days, $\frac{1}{4} \times \frac{1}{5}$ of an inch.
Above 20 days, $\frac{7}{25} \times \frac{1}{5}$ of an inch.
Above 8 months, $\frac{1}{2} \times \frac{1}{5}$ of an inch.
Above 9 months, $\frac{3}{5} \times \frac{1}{2}$ of an inch.
Above 11 months, $\frac{3}{5} \times \frac{13}{25}$ of an inch.

Tidy[1] sums up the facts observed by himself and others as follows:

"(1) If there be no visible trace of this osseous nucleus the fœtus cannot be more than from 36 to 37 weeks old.

"(2) If it be the size of a hempseed, or the head of an ordinary fly (*i.e.*, about half a line), it corresponds to 37 or 38 weeks, if still-born.

"(3) When from $\frac{3}{4}$ to 3 lines, it indicates a uterine age of about 40 weeks.

"(4) If it measures more than 3 lines, the child has probably survived its birth."

General Characteristics of the Mature Child.—"All the parts are properly rounded off and supplied with a bountiful cushion of fat. The skin has lost the deep red color, and is covered with vernix caseosa only on the dorsal and in the flexor surfaces of the extremities. Lanugo has also disappeared; the hair is usually dark and about one and a quarter inches long; the head is still the most spacious part of the body, and the skull in particular exceeds in size the face, which latter, however, has a marked full roundness. . . . Ear and nasal cartilages are hard to the touch; eyebrows and lashes are distinctly developed; the thorax appears rounded, the breasts are in both sexes relatively strongly developed, and contain some secretion.

"Fully developed children look about in a lively manner; they move their extremities vigorously and cry aloud; they evacuate urine and intestinal contents soon after birth, make attempts at nursing, and eagerly and strongly seize the offered mammæ. Deviations from the . . . average are frequent" (Spiegelberg).

---

[1] Legal Medicine," vol. iii., p. 37.

THE CHARACTERISTICS OF THE EMBRYO AND FŒTUS DURING THE SEVERAL MONTHS OF GESTATION.

The following description has been taken from the last edition (1891) of Spiegelberg-Wiener's "Text-book of Midwifery."

At the end of the **first month** the embryo, according to His, has a length of from $\frac{7}{25}$ to $\frac{3}{10}$ inch and is markedly curved upon itself, the head and breech being nearly in contact. The head is almost at a right angle to the neck. The divisions of the brain can be recognized on the head; the mid-brain projects most markedly forward. The eye is relatively small, and the lens is nearly closed. The nose appears as an extensive oval area surrounded by thick margins. The pharyngeal arches are broad strips extending up to the cerebral hemispheres. Both extremities are broad flaps which are slightly constricted at their junction with the body, and are without distinct articulations. In the space within the somatopleure, visible from without, lie the heart, the liver, and the starting-point of the thick, short, abdominal pedicle. The umbilical vesicle is already pedicled. The umbilical cord proceeds to the right of the abdominal pedicle from the body, while the blunt caudal extremity of the body usually lies at the left of it. Of the youngest known ova, that of Reichert was expelled fourteen days, that of Breus ten days, and the first one of Thomson fourteen days after the cessation of menstruation. Concerning the age and phase of development of young human embryos His establishes the following scale:

Embryos of	2 to $2\frac{1}{2}$	weeks,	$\frac{1}{12}$ to $\frac{1}{8}$ inch.
"	$2\frac{1}{2}$ to 3	"	$\frac{1}{8}$ to $\frac{1}{6}$ inch.
"	$3\frac{1}{2}$	"	$\frac{1}{5}$ to $\frac{1}{4}$ inch.
"	4	"	$\frac{7}{25}$ to $\frac{1}{3}$ inch.
"	$4\frac{1}{2}$	"	$\frac{2}{5}$ to $\frac{11}{25}$ inch.
"	5	"	$\frac{1}{2}$ inch.

Arranged according to the size of the chorion, there exists the following scale (His):

Chorion	under	$\frac{3}{5}$ inch,	embryo	between	$\frac{1}{12}$ to $\frac{1}{6}$ inch.
"	from	$\frac{3}{5}$ to $1\frac{1}{5}$ in.	"	"	$\frac{1}{6}$ to $\frac{2}{5}$ "
"	"	1 to $1\frac{3}{5}$ "	"	"	$\frac{2}{5}$ to $\frac{3}{5}$ "
"	"	$1\frac{2}{5}$ to 2 "	"	"	$\frac{3}{5}$ to $\frac{4}{5}$ "
"	"	$1\frac{3}{5}$ to $2\frac{2}{5}$ "	"	"	$\frac{4}{5}$ to 1 "

At the beginning of the **second month** the embryo, according to His, measures $\frac{1}{3}$ to $\frac{3}{8}$ inch, and at the end of the month, $\frac{7}{8}$ to 1 inch. The definite transition from embryo to fœtus takes place during the stages of development from $\frac{3}{5}$ to $\frac{2}{3}$ inch. The head rises pretty rapidly so that the mid-brain projects more and more beyond the cervical eminence. The external configuration at the head and trunk is more and more uniformly rounded off, the superior maxillary process coalesces definitely with the lateral portion of the nose, and the last transitory furrows and fissures of the body surface disappear. The lips become more distinct at the oral fissure, and the auricles at the ear openings. The several parts of the extremities increase in length, and at the foot the toes begin to be differentiated. In embryos of $\frac{2}{3}$ inch up to the end of the second month the back is straightened so far that a vertical line from the vertex strikes the body close behind the coccyx which still projects anteriorly below the external sexual and anal region. Brain and liver enlarge considerably, especially the former, so that at the end of this period the head exceeds the trunk in size. The first rudiments of the lids develop around the eyes in the shape of low folds, the auricle becomes more distinct, the extremities project more in front, and extend considerably beyond the trunk at the end of the period. The finer articulation of the extremities has already advanced greatly.

Toward the end of the **third month** the ovum is $3\frac{3}{5}$ to $4\frac{2}{5}$ inches long; the chorion has lost a great part of its villi, and the placenta is formed, though still very small. The funis has become much longer and twisted; it is inserted very near the lower end of the trunk. The intestine is withdrawn from the umbilical aperture. The embryo measures 3 to $3\frac{1}{2}$ inches and weighs about one ounce. The neck now separates the head from the trunk; the latter, by the development of the ribs, is distinctly divided into chest and abdomen. Oral and nasal cavities are separated by the palate; the lips close the mouth; rudimentary teeth begin to develop in the maxillæ. Points of ossification have formed in most of the bones; fingers, toes, and traces of the nails may be observed on the extremities. Scrotum and labia develop, but penis and clitoris are still of equal length.

Toward the end of the **fourth month** the placenta is thicker and larger, the funis more twisted and thicker. The fœtus is

4 to 7 inches long, weighs on an average 2 ounces; the length of the head is one-fourth that of the body. The cranial bones are partly ossified, but show very wide sutures and fontanelles. The face is quite distinct; mouth, nose, eyes, and ears have their proper shape. The sex can be distinguished; the skin is firmer; hair begins to develop. The fœtus commences to make occasional though slight movements with its limbs.

A fœtus of the **fifth month** is 7¼ to 10¾ inches long and weighs nearly 9 ounces, but the liquor amnii exceeds it in weight. The head is relatively still very large, the face has a senile appearance. The eyelids begin to separate. Lanugo is distinctly present, mainly at the place of the eyebrows and on the forehead. The skin is richer in fat and, therefore, more resistant; its surface is coated, though still sparsely, with vernix caseosa—a white fatty substance consisting of epidermal scales, lanugo, and sebum. The mother feels "quickening." Fœtuses born toward the end of the fifth month sometimes breathe for a short while and move their limbs.

Toward the end of the **sixth month** the fœtus measures 11 to 13½ inches and weighs about 22 ounces. The head is relatively still very large. The upper part of the chest looks more arched, owing to advanced development of the pectorales; the gluteal muscles are more strongly developed; the entire trunk is fuller. The insertion of the funis is higher up, in the middle third between symphysis and ensiform process. The lids have separated; lashes and eyebrows are more prominent; the hair of the head is longer and gradually loses the character of lanugo. The testicles approach the inguinal rings. Bile-stained contents in the intestines, sometimes also meconium in the upper part of the large intestine. A fœtus born at this time moves and makes faint efforts at inspiration, which, however, soon cease.

Seventh Month.—Length of fœtus, 14 to 15 inches; average weight, 38 oz. The head, still very large, is firmer; the extremities are rounding off; but the skin is still greatly wrinkled. A testicle is often found at the external inguinal ring. At the beginning of the seventh month the whole body is covered with hair, most thickly on the forehead, cheeks, around the mouth, and at the nucha. On the trunk the hair is close but shorter, while on the extremities it is sparse and partly absent. The larger part of the rectum contains meconium. The pupillary membrane has nearly always disappeared by the end of the month. Fœtuses born alive between the 24th and 28th weeks perish, as a rule, very soon.

Eighth Month.—Length, $15\frac{1}{2}$ to $16\frac{1}{2}$ inches; weight, $50\frac{1}{2}$ oz. Funis inserted $\frac{3}{5}$ to $1\frac{1}{5}$ inch above the middle of the line from the ensiform process to the symphysis. The hair of the scalp is denser, the lanugo is beginning to disappear from the face. The nails have become harder, but do not yet reach to the finger-tips. A testicle is usually found in the scrotum. At the end of the eighth month ossification begins in the lower epiphysis of the femur. A fœtus born about this time may be kept alive with some care.

Ninth Month.—Length, 17 to $17\frac{3}{4}$ inches; weight, $62\frac{1}{2}$ oz. The body is more rounded in form by the greater development of fat; the face is relatively larger and more pleasant; the formerly numerous milia around the mouth and on the cheeks gradually disappear. The cranial bones are still quite flexible, the nails not yet fully developed. There is more hair on the scalp and less lanugo. Children of this period approach the mature ones in their vital activities, but they are much less energetic, mostly somnolent, and they usually perish unless carefully nursed

Tenth Month.—In the first weeks the fœtus measures 18 to 19 inches and weighs 75 oz. It gradually assumes the characteristics of the full-term child and possesses them in the last two weeks.

The measurements and weights given are Hecker's; those obtained by Ahlfeld are greater.

In estimating the age we should consider both the general development and that of special parts. The weight is less reliable than the length.

The length, at the beginning of the fifth week (measured from the parietal curvature along the middle line of the back down to the coccyx), amounts to $\frac{3}{5}$ inch and increases $\frac{1}{5}$ inch every following week, so that at the end of the eighth week it reaches $1\frac{2}{5}$ inches.

The length of the extended body (from vertex to heel) is $2\frac{4}{5}$ inches at the end of the third month, $4\frac{3}{4}$ inches at the end of the fourth month, 8 inches at the end of the fifth month, 12 inches at the end of the sixth month, 14 inches at the end of the seventh month, 16 inches at the end of the eighth month, 18 inches at the end of the ninth month, and 20 inches at the end of the tenth month; thus increasing by two inches each month from the end of the sixth month.

The most available criteria afforded by single parts are: the development of the hair, the appearance and size of individual centres of ossification, and the degree of development of certain portions of the brain. A centre of ossification appears in the calcaneum at the beginning of the seventh month and may reach $\frac{1}{8}$ inch in diameter; it grows in length until, at the end of the eighth month, it measures $\frac{1}{6}$ to $\frac{7}{25}$ inch; at the end of the ninth month $\frac{1}{4}$ to $\frac{2}{5}$ inch; at the end of the tenth month, $\frac{3}{8}$ to $\frac{1}{2}$ inch. Ossification commences in the astragalus at the beginning of the eighth month. The ellipsoid nucleus measures at the end of the eighth month $\frac{1}{12}$ to $\frac{1}{8}$ inch; at the end of the ninth month, $\frac{1}{5}$ to $\frac{1}{4}$ inch; and at term, $\frac{7}{25}$ to $\frac{3}{8}$ inch. The centre of ossification in the lower epiphsyis of the femur, as a rule, does not appear before the ninth month.

The centres of ossification in the upper epiphysis of the tibia, and in rare cases in the upper epiphysis of the humerus, show themselves toward the end of the tenth month; if they are present, one may safely assume that the fœtus is fully developed. Their absence, however, does not necessarily indicate immaturity.

Of importance in the estimation of the age of the fœtus is, finally, the appearance of the surface of the brain, particularly the region of the fissure of Sylvius, whose development corresponds to certain periods of time. In the seventh month it is still a wide, nearly triangular pit; it contracts and deepens in the eighth month; while in the ninth month the parts surrounding the fissure (the frontal and temporal lobes) approach each other more and more, so that the fissure is completely developed at the end of the month. Furthermore, while in the ninth month only the main fissures and convolutions are developed, at the end of the ninth or beginning of the tenth month numerous secondary or accessory fissures appear, and the whole brain is strikingly richer in convolutions.

See ABORTION, Vol. II., pp. 361–363.

THE FULLY DEVELOPED FŒTUS.

According to Spiegelberg's measurements, it is on an average $20\frac{1}{2}$ inches long and weighs 6 lbs. $14\frac{1}{2}$ oz. The breadth of the shoulders, the bis-acromial diameter, is about $4\frac{3}{4}$ inches, and their circumference about $13\frac{1}{2}$ inches; the dorso-sternal diameter is $3\frac{1}{2}$ to $3\frac{3}{4}$ inches; the bis-iliac, $3\frac{3}{4}$ to 4 inches (see p. 287).

The umbilical cord is inserted just below the middle of the long axis of the body (even from the sixth to the seventh month its point of insertion in the abdomen is unchanged; its distance from the symphysis is to its distance from the ensiform process as 1:1.6—Hecker).

Meconium,[1] consisting of thickened intestinal mucus, of intestinal epithelia, swallowed liquor amnii (epithelial shreds, lanugo, and vernix), of a deep dark color, owing to the presence of bile (cholesterin and bilirubin crystals), is now only to be found in the rectum.

The centre of ossification in the lower epiphysis of the femur is about $\frac{1}{5}$ inch long, but it may also be much smaller or even absent.

The heaviest fœtus which Spiegelberg found in his clinic weighed 11 lbs. $7\frac{1}{2}$ oz. and measured 23 inches. (In private practice Spiegelberg extracted a child of 13 lbs. $3\frac{1}{2}$ oz. and $22\frac{3}{4}$ in length.) In general, the length increases with the weight, but by no means proportionately.

The physical development of the fœtus is influenced by (1) its sex; boys being on an average longer and heavier than girls. (2) The number of pregnancies. Children of primiparæ weigh on an average $4\frac{1}{4}$ oz. less than those of multiparæ, though their length differs little. (3) The age of the mother. The weight generally increases up to the thirty-ninth year. (4) The constitution and vigor of the parents. It is a matter of course that the nutrition of the maternal body is important to the development of the child's body, and tall women, according to Fasbender's numerous measurements, bear heavier and longer children.

In proportion to the head, the trunk is generally more strongly developed in girls; this greater development concerns the transverse direction alone and is based on a larger quantity of the panniculus adiposus. Thus even at birth the contrast between female and male body is marked.

---

[1] Zweifel: Arch. f. Gyn., vii., p. 474.

Proportion of births: 100 girls to 106 boys (according to Veit, 100 : 105.88 in Prussia).

ILLUSTRATIVE CASES OF EARLY VIABILITY.

1. *Parvin:* "*Science and Art of Obstetrics*," *Phila.*, 1886, *p.* 139.—"In one instance in my practice a child was born weighing only one pound and a half, the pregnancy ending a few days before the completion of the seventh month; the child lived, and is now a healthy boy of seven years."

2. *Kolowko, A.: Centralbl. f. Gynäk., Leipzig,* 1890, *xiv.*, 235–237.—On the question of the viability of very small and immature children, a case cited was one where the last menstruation occurred in April, and the child was born October 5th, making the duration of pregnancy about twenty-seven weeks. The child lived and increased rapidly in weight.

3. *Stevens, E. B.: Obstet. Gaz., Cincin.*, 1882, *v.*, 568–571.—Viability of the premature fœtus.

4. *Routh, C. F. H.: Trans. Obst. Soc., London,* 1871, *xiii.*, 132.—Case of viability in a child born at five and a half months.

5. *Madden, T. M.: Obst. Jour. Gr. Brit., London,* 1873–74, *i.*, 80–89.—On the early viability of the fœtus in premature deliveries.

6. *Tidy, C. M.:* "*Legal Medicine*," *W. Wood & Co., New York, vol. iii., pp.* 54–56.—Cases of early viability. Here will be found the record of forty-eight cases with the period of utero-gestation ranging from four to six months, together with the references and remarks upon the appearance, weight of the child, etc.

7. *Githens: Amer. Jour. Obst., New York,* 1876, *ix.*, 666.—Viability of a six-months' fœtus.

8. *Hubbard, C. J.: N. Y. Med. Jour.*, 1890, *li.*, 491.—The birth of a very small living child (18 oz.). Length, 10 in.; head, 3 in. in length and 8 in. in circumference around the ears; thighs, 2½ in. in circumference; finger-nails perfect; emaciated; lived eight hours. Mother considered herself pregnant seven and a half months.

9. *Maison: Soc. de Méd. lég. de France, Bull. Paris,* 1881–82, *vii.*, 146–150.—Note sur la viabilité des nouveau-nés.

10. *Moore, J. H.: Med. and Surg. Reporter, Phila.*, 1880, *xlii.*, 351.—A case of early viability.

11. *Polaillon: Ann. d'Hyg., Paris,* 1877, *xlvii.*, 535–546.—Rapport sur un cas de viabilité.

12. For recent literature upon the early viability of the child see the following references:

Gilbert, A.: Zeitschr. f. Geburtsh. u. Gyn., Stuttgart, 1888, *xvi.*, 53–56.

Charpentier et Butte: Compt. rend. Soc. de Biol., Paris, 1889, *i.*, 652–655. (*Nouv. Arch. d'Obst. et de Gyn., Paris*, 1889, *iv.*, 545–550.)

Von Brehm, H.: St. Petersburg med. Wochenschr., 1890, F. *vii.*, 77.

Bailly: Arch. de Tocol., Paris, 1879, *vi.*, 756–761.

Cullingworth, C. J.: Obst. Jour. Gr. Brit., London, 1878–79, *vi.*, 163–168.—Case illustrating the viability of extremely small premature children; with brief reference to several analogous examples.

Fochier, A.: Mém. et Compt. rend. Soc. d. Sc. Méd. de Lyon (1877), 1878, *xvii.*, 2 *prt.*, 28–36. *Lyon Méd.*, 1877, *xxiv.*, 441–446.—Note sur l'appréciation de la viabilité en médecine légal.

III. RESEMBLANCES—MOTHER'S MARKS.

The medico-legal importance of resemblances, physical and mental, concerns questions of paternity in bastardy cases, and in instances where a child substituted for another claims to be the heir to an estate.

Again, a woman shortly after the death of a first husband marries a second. Within ten or perhaps eleven months later, a child is born, and the question of paternity arises.

In such cases **likeness to the parent** is rightfully held as an important proof of paternity.

Most works upon medical jurisprudence cite an instance which occurred in Appenzell in Switzerland. In a bastardy case, the question arose which of two men, both of whom had had connection with the woman within seventeen days, should be held to be the father of the child in question. The court postponed the case, in order that the likeness to the father might develop itself.

Tidy[1] says: "The evidence in these cases must be chiefly circumstantial. Access being proved, the following questions arise: (*a*) Is the period intervening between the time when access was possible and birth (supposing the child to be mature) the normal period of utero-gestation? (*b*) If the period be protracted beyond 280 days, is it within the possible range of protraction, as laid down by authorities and proved by cases? (*c*) If the period be short duration, does the appearance of the child correspond with its asserted uterine age, and is the period one within which, according to authorities and recorded cases, a living child might possibly be born? (*d*) If the child be immature, what is its probable age?"

---

[1] "Med. Jur."

Deformities, as is well known, may be transmitted from parent to offspring. In deciding a case upon such evidence we are met with the fact that certain authorities believe that it is quite possible for the mind of the pregnant woman to be influenced by the mere sight of the deformity in the person of the alleged father of her child, and that this impression has affected the child.[1]

Again, it must be remembered that **color** may be transmitted and may serve as important evidence.

Associated with the medico-legal question of resemblances and parentage is the **effect of former impregnation.** There seems to be abundant proof that in cases where a woman marries a second time, her children may resemble neither parent but the first husband.[2]

And then, finally, it must be borne in mind, that while it is the rule for children to resemble their parents or ancestors,[3] yet there are exceptions where absolutely no likeness is present.

"Children may or may not resemble their parents in the color of the skin, hair, eyes; in certain anatomical conditions and peculiarities, as hypospadias, transposition of viscera, etc.; in power of procreation; in longevity; in peculiarities of voice, gait, and gesture, and in the predisposition to certain diseases. In other words, the absence of likeness, of transmitted defects, and of other peculiarities, neither disproves paternity nor proves legitimacy" (Tidy).

---

[1] See Reese: "Med. Jurisp.," Phila., 1889, p. 543.

[2] "It is known to breeders of horses and cattle, that the influence of the impregnation by one sire may be extended beyond the foal begotten at the time, and affect those begotten subsequently by another sire. This is proven by the later colts, or calves, bearing the peculiar markings of the first sire. The question, therefore, might be suggested whether the same *handing down* of parental likeness to the children of a subsequent father might be possible. Without any positive data on which to venture an opinion, it may, nevertheless, be suggested here as a circumstance to be considered in certain cases of affiliation" (Reese).

[3] "The fact that a child may bear a more striking likeness to its grandparents or to other relations, or what is more astonishing, to some very remote ancestor, is well known" (Tidy).

ILLUSTRATIVE CASES OF RESEMBLANCES AND MOTHER'S MARKS.

1. *Stothard v. Aldridge* (Bail Court, Jan., 1856) (Quoted by Tidy).—The plaintiff sues the defendant for damages for the seduction of his wife. Defendant was a man of color. The child born of the alleged adulterous intercourse was proved by the medical witness to have been born colored, and to have had woolly hair. The husband and wife were both light. The complexion of the child fixed the paternity on the black defendant.

2. *Parsons: Phil. Trans., vol. lv.* (Quoted by Tidy).—(1) A black man marries a white woman. A daughter is born resembling the mother in features and color, except that the right buttock and thigh were black. (2) Another case was that of a black man who married an Englishwoman. The child born as the result of the marriage was quite black. (3) A third case reported by the same author was that of two black parents having a white child. The mother was fearful her husband would suspect her of unchastity. The father stated that his own father was a white man and further said: "My grandfather and grandmother were both as black as you and myself; and although we came from a place where no white people were ever seen, yet there was always a white child in every family belonging to us."

3. *Douglas Peerage Case*, 1767–69.—Lord Mansfield, in delivering the judgment to the House of Lords, expressed a very decided opinion in favor of the parental likeness which the claimant bore to his father, as constituting an important link in the chain of evidence. (See "Collectanea Juridica," London, 1792, Vol. II., p. 386. Also Beck, Tidy, Taylor, Wharton, and Stillé, and Reese upon Medical Jurisprudence. "American and English Encyclopædia of Law," 1891, Vol. XV., p. 215.)

Lady Jane Douglas was married August 10th, 1746, to Colonel Stewart. She became pregnant, and the fact was notorious in January, 1748. On the 10th of July, 1748, being in her fiftieth year, she was delivered of twins in Paris. Of these, one (Sholto) did not live to manhood, but the other (Archibald) did. Lady Jane, after their birth, had a miscarriage. In progress of time both father and mother died. Their positive declarations had convinced the Duke of Douglas, and he left his dukedom and other estates to his nephew and their son Archibald, who was the appellant in the case.

The Duke of Hamilton opposed the claim on the ground that they were supposititious children.

The case came up for final adjudication in the House of Lords in 1769, when Lord Chancellor Camden and Lord Chief Justice Mansfield decided in favor of the appellant.

The following extracts from the decision of Lord Mansfield are interesting, both as to the age at which pregnancy is possible and probable and as to the resemblances of children to their parents :

"Lady Jane became pregnant in October, 1747, at the age of forty-nine years—a thing far from uncommon, as is attested by physicians of the first rank, and confirmed by daily experience. It is further proved that the elder child, the appellant, was the exact picture of his father, and the child Sholto as like Lady Jane as ever child was like a mother. I have always considered likeness as an argument of a child's being the son of a parent, and the rather as the distinction between individuals in the human species is more discernible than in other animals. A man may survey ten thousand people before he sees two faces perfectly alike, and in an army of a hundred thousand men every one may be known from another.

"If there should be a likeness of features there may be a discriminancy of voice, a difference in the gesture, smile, and various other things, whereas a family likeness runs generally through all these, for in everything there is a resemblance, as of features, size, attitude, and action. And here it is a question whether the appellant most resembled his father (Sir John), or the younger Sholto resembled his mother.

"Many witnesses have sworn to Mr. Douglas being of the same form and make of body as his father ; he has been known to be the son of Colonel Stewart by persons who have never seen him before, and is so like the elder brother, the present Sir John Stewart, that except by their age it would be hard to distinguish one from the other.

If Sir John Stewart, the most artless of mankind, was actor in the *enlèvement* of Mignon and Saury's children, he did in a few days what the acutest genius could not accomplish for years. He found children, the one the finished model of himself, and the other the exact picture, in miniature, of Lady Jane.

"It seems Nature had implanted in the children what is not in the parents, for it appears in proof that in size, complexion, stature, color of the hair and eyes, nay, and in every other thing, Mignon and his wife, and Saury and his spouse, were *toto cœlo* different from and unlike to Sir John Stewart and Lady Jane Douglas."

The House of Lords decided in favor of the appellant, only five peers dissenting.

"The Amer. and Eng. Encyclopædia of Law," Northport, Long Island, Vol. XV., 1891, p. 215, records the following illustrative cases :

4. *State v. Smith*, 54 Iowa, 104 ; 37 Am. Rep., 192.—In this case the Court said : "A child of the proper age may be exhibited to a jury as evidence of alleged paternity. Precisely what should be deemed the proper age we need not determine. . . . A child which is only three months old has that peculiar immaturity of features which character-

izes an infant during the time it is called a babe. A child two years old or more has, to a large extent, put off that peculiar immaturity. In allowing a child of that age to be exhibited we think the court did not err."

In Iowa a distinction is made as to the admission of a very young infant and a child two years old in favor of the child two years old.

5. *Finnegan v. Dugan*, 14 Allen (Mass.), 107.—Here the Court said: "The fact of a resemblance between the child and the putative father was proper for the consideration of the jury. It is a well-known physiological fact that peculiarities of feature and personal traits are often transmitted from parent to child. Taken by itself, proof of such resemblance would be insufficient to establish the paternity; but it would be clearly a circumstance to be considered in connection with other facts tending to prove the issue on which the jury are to pass."

See also:

6. *State v. Woodruff*, 67 N. Car., 89.

7. *State v. Britt*, 78 N. Car., 39.

8. *Paulk v. State*, 52 Ala., 427.

9. *Stumm v. Hummel*, 39 Iowa, 478.

Also "Amer. and Eng. Encyclopædia of Law," Vol. II., p. 153, Bastardy.

10. *Young v. Makepeace*, 103 Mass., 50.—In this case the defendant in a bastardy proceeding denied that he was the father of the child, but alleged that one Dean was the father. The complainant then offered evidence to show dissimilarity between Dean and the child. Exceptions to the admission of the evidence were sustained, the Court saying: "We think also that the testimony to show points of the similarity between the child and Dean should not have been admitted. Even where there is a noticeable resemblance, there may be equally marked points of dissimilarity."

11. *Eddy v. Gray*, 4 Allen (Mass.), 435.—Points of dissimilarity, not implying a difference of race, do not tend to disprove paternity. They are, at most, of much less significance than points of resemblance, but proof of resemblance was excluded in this case.

12. *Keniston v. Rowe*, 16 Me., 38.—In this case the evidence excluded was of dissimilarity.

13. *Gilmanton v. Ham*, 38 N. H., 108.—In this case the resemblance was held to be properly a matter for consideration by the jury. But in this case the jury had both the child and the putative father before them, and took the fact from their own observation.

14. *People v. Carney*, 29 Hun (N. Y.), 47.—In this case evidence of the color of the child's eyes is not admissible to show its paternity.

See also:

15. *State v. Danforth*, 48 Iowa, 43.

16. *United States v. Collins*, 1 Cranch (U. S.), 592.
17. *Petrie v. Howe*, 4 N. Y. Sup. Ct., 85.
18. *Overlock v. Hall*, 81 Me., 348.
19. *Hanawalt v. State*, 64 Wis., 84.
20. *Robnett v. People*, 16 Ill. App., 299.

And "Amer. and Eng. Encyclopædia of Law," Vol. II., p. 152.

21. *State v. Smith* (Iowa), "Am. and Eng. Encycl. of Law," Vol. II., p. 153.—In this case the court decided that the child, two years and one month old, resembled the putative father "so closely as scarcely to admit of a doubt."

IV. SUBSTITUTION OF CHILDREN—SUPPOSITITIOUS CHILDREN.

In cases of supposititious children, unless there is present some peculiar mark, deformity, or characteristic, or unless there is some decided discrepancy as regards age, little or no positive medical evidence can be offered as regards the child or children.

Where substitution is attempted soon after delivery, or where attention is called to a supposititious child soon after the date of the pretended labor, certain phenomena connected with the umbilicus, skin, weight, and secretions of the child will enable us to state with an approach to accuracy the date of the child's birth.

Umbilicus.—"The stump of the umbilical cord remains relaxed and bluish-white for about twenty-four hours, when the red line of demarcation begins to show itself, which soon becomes moist; beginning with the amniotic sheath of the cord, the gelatin of Wharton and then the vessels are destroyed, while the rest of the cord appears flat, brown, and mummified. When the vessels of the cord have become very thin, it falls off, usually while the child is in the bath, from the third to the sixth day; somewhat later in small or prematurely born children than in those who are strong" (Winckel).

"In three-fourths of infants born at term the stump of the umbilical cord falls off within five days, but in premature infants the time is longer. The raw surface left by its detachment does not cicatrize for eight or ten days."[1]

---

[1] Parvin: "Science and Art of Obstetrics," Phil., 1886, p. 544.

Skin.—The physiological icterus appears about the third to the fifth day (Winckel). See also Characteristics of the Fully Developed Child (p. 284).

Weight.—The child loses in weight during the first three or four days, for various reasons. "The navel having healed up, if the child is healthy and nursed by a healthy mother, it begins to gain again about the fourth day, and by the seventh or eighth day is as heavy as it was at birth" (Winckel).

Secretions.—The meconium, dark brown in color, so named from its resemblance to the juice of the poppy, may usually be observed in the discharges from the bowel for three or four days after birth, after which the stools become light canary or saffron colored. A microscopical examination of the meconium reveals lanugo, epithelial cells, and nuclei.

Instances have occurred in which women have pretended that they have been recently delivered and a child has been produced in proof of the same. In such a case all doubt is removed by a thorough and careful physical examination of the woman (see Feigned Delivery). Even in those instances in which a medical examination fails to elicit positive proof, or where, for some reason, the examination cannot be obtained, "the imposture is apt to be disclosed by some accidental or unforeseen circumstance."[1]

Upon the substitution of children, Casper ("Forensic Medicine," New Sydenham Society, London, 1864, Vol. III., p. 397) says:

"This deceit, which the Penal Code threatens with a degrading imprisonment for many years, is but of rare occurrence in ordinary life; not, as is usually said, because the interests at stake are not of so much importance as where one heir to a property or to a throne is substituted, since his own interests seem to each individual quite as important as these, but because the deceit is very difficult to set agoing and to carry out, and because it requires the assistance of cognizants and accomplices, unless indeed the child be stolen, as in a case of Klein's 'Annals of the Law.' In this case a peasant-woman wished to force a marriage. She made the man drunk, induced him to have intercourse with her, feigned pregnancy, and finally set fire to a house in which a neighbor had been delivered of twins, stole one of these children, and produced it as her own child of which she had been delivered. In other cases the extortion of money from the alleged seducer and father, more rarely the affecting wish of a childless wife to gladden her spouse by making him a father (this was the cause of the last case of the kind which came before me), finally in most cases the desire to obtain an inheritance of some kind or other, is the moving cause of a fraud of this nature.

---

[1] Wharton and Stillé, vol. iii., p. 29. In the recent Hamilton case in this country, a quarrel between the mistress and the supposititious child's nurse was the primary cause of the disclosure of the fraud.

"The writers on this subject have been also guilty of introducing, in regard to it, ideas foreign to forensic medicine, when they continually speak of the 'genuineness' of the 'legitimacy,' and of the 'power to inherit' of the child, ideas which belong to the statute book and the science of law, and with which forensic medicine has nothing to do. The latter has only to consider the criteria according to which it may be actually determined in any given disputed case, whether this woman has given birth to this child, as she asserts she has, while the opposing party declares she has not, and that the child is supposititious.

"More rarely, the case of substitution is, as it were, relative; that is, the fact disputed is not whether the woman has been delivered or not of the child in question, as whether this child has been begotten by this man, who asserts that the child is supposititious as far as he is concerned. Both cases coincide in regard to the medico-legal examination. In the first place, it is necessary to determine whether the alleged mother has ever given birth to a child at all. The signs of delivery (pp. 36, 37) will decide this point. If it should be discovered that she has never given birth to any child, then the fraud is at once proved. The case is more difficult where she has produced a child, but perhaps one of an undesired sex, such as a daughter when a male descendant was required, or when, instead of a living child, which alone could serve her purpose, a dead one has been born.

"In order to ascertain the truth in these cases, when possible, the age of the child said to have been born must be ascertained and compared with the alleged period of delivery. A fraud might thus be possibly easily detected, such as, for instance, when a child alleged to be three days old is exhibited with a completely formed navel. Has, however, the alleged mother, who has actually produced, had the cunning to substitute a child of the same age with her own,—then the medical jurist will, in general, have to declare the impossibility of his being able to give a decisive opinion. Because the resemblance of the child to its putative father, which we are advised to pay attention to, is a most uncertain mode of proof, particularly in the case of new-born or very young children. In such children, especially in the new-born ones, the resemblance in features to parents or relations is, in most cases, not yet developed; moreover, the power of discovering a likeness is something quite individual; and, finally, it is well known that it is no law of nature that children must resemble their father or mother, and that many exceptions occur to this. Yet it is but a few years since a singular case came before me officially, in which the criterion was of itself sufficient; it was a case of what I have termed relative substitution, in which the resemblance was based upon the difference of race. A white woman had a liaison with a negro of this city, and had a son by him aged four years, who exhibited all the peculiarities of a true mulatto. The woman, however, produced a second boy, the paternity of which the negro denied, as he suspected the woman of having had intercourse with a (white) laborer. The second child, eleven months old at the time of my examination, was, however, also a completely developed mulatto, and could, not, therefore, have been begotten by a white man out of its white mother. In this case, therefore, the absence of fraud was indubitable. It is somewhat remarkable that a precisely similar case had occurred in Berlin in the year 1790. It gave occasion to a report by the superior medical college, which gave itself the trouble of proving by many quotations, 'that a white child born by a white mother could not have been begotten by a black man.' Remer goes still further than the mere difference of race, for he points out that congenital family peculiarities descend for generations; and of this he gives illustrations, such as a crooked little finger on each hand, red hair, stuttering, absence of the same finger-joints, and blindness; and modern physiological experience might very much enlarge the list. Remer asserts that when such peculiarities are observed upon a child said to be supposititious, that then its 'genuineness' is certain; but, however, when these are absent, the reverse is not to be concluded with certainty, but suspicion is justified. This assertion is tenable enough when the malformation or peculiarity in question is remarkable and indubitable, and is also of rare occurrence, but it must not be made to include 'red hair' or 'stuttering' and the like, which from their frequency might occur by chance, nor even a mole, etc., which might lead to mistakes; just because, however, such cases are of extremely rare occurrence as judicial ones, so, therefore, this criterion, taken from the resemblance of the child, is almost worthless for medico-legal practice. Just because, on the whole, frauds perpetrated by the substitution of children are, in a medico-legal point of view, always difficult, and under many circumstances impossible to detect, while their results are of the highest importance to families, morality, ay, even to public weal; therefore families and nations, from olden times, prescribed by statute certain precautions for the prevention of these frauds. In ancient dynasties, as in the Bourbons, the birth of a new member and possible heir to a throne is attended by solemn statutory forms, which have for their object and intention that the whole act of delivery should proceed before trustworthy witnesses, the highest officials of the crown and state, etc., which is certainly the sole method of attaining perfect certainty. In all statute books similar regulations are contained. These commence to take action in the respective cases even during pregnancy, which is submitted to a continuous control, etc.,—but forensic medicine does not require to enter further upon this subject. It has also been imagined that in a case of twins the second-born child might be preferred, and, as it were, substituted for the first-born, and endeavors have been made to ascertain how a substitution of this character could be found out."

ILLUSTRATIVE CASES OF THE SUBSTITUTION OF CHILDREN.

1. *Balfour, T. A. G.: Brit. Med. Jour., Feb. 14th,* 1880, *p.* 241.—Dr. B. attended a Mr. X. at his death. Two months afterward he was sent for to see Mrs. X., and was given to understand (a nurse being in the room at the time with an infant in her arms) that she had been confined. He was told that the child had been born at 5 P.M. the previous evening, before the nurse had arrived. She explained she had not sent for the doctor because it was a rough night, and that a neighbor had waited on her. The chemise was well stained with blood. On examination, however, it was evident that she had never given birth to a child. Further, the age of the child did not correspond to the time of its supposed birth. She confessed at last that it was not her child. An after-birth had been sent to her along with the child shown, in order to make the case appear the more real. The object of the deception was to acquire property which otherwise would have gone to her husband's relatives. In this case the husband had died two months previously, intestate, leaving some property, of which one-third only would revert to the widow. The widow stated to friends of her husband that she was pregnant and that she expected to be delivered in two months. At the expiration of this time an unmarried woman is delivered of a child at some distance, and the scheming widow obtains both child and after-birth, betakes herself to bed; and calls her physician as above stated.

The deception was discovered, both from an examination of the woman and the substituted child's navel, which latter was a day older in appearance than would correspond to the date of the alleged delivery. The conclusion to be drawn is, that not even the presence of both child and after-birth is sufficient to establish the diagnosis of delivery.

2. *R. v. Skepelhorne and wife. Brit. Med. Jour.*, 1870, *I., p.* 88; Central Criminal Court, Feb., 1870 (quoted by Tidy).—The prisoners were charged with conspiring to deceive a man named Ironside, by falsely representing that his wife had given birth to a female child. Mrs. Ironside, who had been married about nine months, was in collusion with the prisoners. The child of another woman was secured, and the

nurse obtained a "sheep's pluck" (which they afterward burned) to represent the after-birth. Dr. Taylor justly says that medical men must not consider all stains or marks of blood on bedding in a room as conclusive proof of delivery. In his charge to the jury Mr. Justice Byles remarked on the enormity of such a crime, where large estates and the rights of legitimate heirs were concerned. He thought, however, Mrs. Ironside did it mainly to please her husband. The prisoners were convicted.

3. *Robert Ray Hamilton Case, New York.*—Mr. Hamilton kept a mistress. Some time in the latter part of 1888 she represented to him that she was pregnant by him. He believed this to be the case, and he gave her considerable sums of money to enable her to go into the country and be confined. She went away, remained a few months, and upon her return produced a child which she stated was the child born at her alleged recent confinement. He fully believed her story and accepted the child as his own.

It appears from the police memoranda that several children were bought from midwives for sums of from ten to fifteen dollars, and that two of these died while acting their parts of supposititious children.

For some cause the fraud was finally discovered, and the woman with her accomplices was indicted for obtaining money by false pretences. The indictment never came to trial.

4. *Rüttel: Henke's Zeitschrift* (quoted by Wharton and Stillé, Vol. III., p. 29).—A girl, in order that she might persuade her lover to marry her, feigns pregnancy and delivery. She steals an eight or ten weeks' old infant and pretends that it is her own. The fraud is quickly and easily discovered; first, from the entire absence of any signs of a recent delivery; and, secondly, from the child evidently being much older than was consonant with the alleged date of birth.

5. *The Wicklow Peerage Case* (Committee for Privileges, April 1st, 1870, reported by Drs. Taylor and Tidy).—The title and estates of the Earl of Wicklow passed at his death to his brother's issue. The first in succession was George Howard, who after a career of dissipation died in October, 1864. He had been married in February, 1863, to Ellen Richardson, a coachman's daughter. In default of issue the estates devolved on his brother Charles, the second in succession. Ellen Howard (*née* Richardson) produced a male child, born, she alleged, on the 16th of May, 1864, and who, if such were the case, would be the son of her husband, George Howard, and the rightful earl.

Mrs. Howard was at the time living in lodgings, and the lodging-house keepers, Mr. and Mrs. Bloor, and a sister of the latter, one Rose Day, were the principal witnesses in favor of the claimant. Mrs. Howard was, or professed to be, taken suddenly ill on the date mentioned. Mr. Bloor went for a doctor, who was not at home. On returning, he was told that Mrs. Howard had been confined, and saw an infant in Rosa's arms. This was the whole of the evidence for the child's parentage.

The Lord Chancellor observed that the evidence was given by the witnesses with a firmness of demeanor and an absence of hesitation which would have commanded credence, unless it had been contradicted by all the surrounding circumstances. No medical man and no nurse attended Mrs. Howard, although it was her first confinement, and the infant would have been a seven months' child. It was neither registered nor baptized.

There was further strong evidence that she had not borne a child. and that the child she produced as her own was obtained by her from a girl who had been recently delivered in the Liverpool workhouse. Mrs. Howard was clearly identified as the person who had taken away a child from the workhouse about this time. Her story was thus proved to be false. The House of Lords decided against her claim and came to the conclusion that the witnesses had been guilty of perjury.

DISPUTED PREGNANCY, LABOR, AND THE LYING-IN STATE.

Under this heading we shall deal with the following subjects:

I. The symptoms and signs of pregnancy in the living.

II. Feigned pregnancy; feigned labor; feigned lying-in state; signs of recent delivery in the living; signs of recent delivery in the dead; corpus luteum.

III. The impregnation of a second ovum, an embryo already occupying the uterus; superfœtation.

IV. The period that must elapse after delivery before the woman can again become impregnated.

V. Unconscious impregnation, pregnancy, and delivery.

I. THE SYMPTOMS AND SIGNS OF PREGNANCY IN THE LIVING.

Diagnosis of Pregnancy in the Living.

The classification[1] and division of the various symptoms and signs of gestation, which seems to the writer to be by far the most convenient for the legal physician, and appropriate for

---

[1] Very many classifications of the different symptoms and signs of pregnancy are proposed by various obstetric authorities. Some speak of the symptoms of pregnancy, others merely of the signs, and still others of the symptoms and physical signs.

We hear of subjective and objective symptoms, of rational and the present work, is to group them collectively as signs, and to enumerate them, not in point of time, but according to their relative value, commencing with the least. We shall describe then:

I. The doubtful signs of pregnancy.
II. The probable or presumptive signs of pregnancy.
III. The certain, positive, or sure signs of pregnancy.

I. Doubtful Signs of Pregnancy.

1. **Morning Sickness.**—Gastric disturbance in the form of nausea and vomiting is in some cases the earliest sign of pregnancy.

Dr. Montgomery says: "I attended a patient who was married on Monday and began to be squeamish on Saturday; her delivery took place within nine months."

It is not a constant sign of pregnancy. In some cases it is entirely absent, in others so severe as to imperil the life of the woman. It occurs in more than one-half the cases of gestation, is more frequent and severe in primiparæ and in women of a highly nervous organization. Appearing in the fourth or fifth week of gestation, it continues with varying severity, usually until the fourth month. In rare cases we observe it continuing through pregnancy.

Nausea or actual vomiting most often troubles the pregnant woman when she first attempts to arise in the morning. More often there is nausea and retching without actual vomiting. After a varying period of nausea and retching the woman succeeds in bringing up a quantity of glairy mucus. The trouble may then disappear and she may even enjoy her breakfast, or

sensible, and of doubtful, presumptive or uncertain, probable, and certain signs of gestation.

One authority classes each symptom in the order in which it presents itself as regards time according to months, another according to periods (three months each).

It may be stated here that the first class—the doubtful signs of gestation—are so uncertain that they may be observed in the male as well as in the female under certain conditions. They are the result of the changes that are going on in the maternal organism, and are produced partly by pressure and partly by alterations in the mother's blood, skin, and nervous system due to other causes.

The second class—the probable signs of pregnancy—have their origin almost entirely from the genital organs of the woman, and have to do then entirely with the mother.

The third class—the certain signs of pregnancy—are produced by the presence of a fœtus within the uterine cavity, and consequently concern the child alone it may persist with greater or less severity for the entire day. It may even awaken her by night and cause her to vomit.

The attempt has been made (Dewees) to attach a diagnostic significance to the spitting by a woman of a white, frothy mucus —"cotton spitting" as it is sometimes called.

Morning sickness, as an indication of pregnancy, when standing alone is merely a doubtful or uncertain sign. Associated with other signs it may even render the diagnosis probable. For instance, a woman in apparent perfect health suffers at the same time from morning sickness, amenorrhœa, some slight enlargement of the abdomen, and perhaps a frequent desire to pass water during the day while in the erect or sitting posture.

2. **Sympathetic Disturbances.**—These involve

(*a*) The Nervous System.—Here various manifestations are presented. An unusual irritability of temper may show itself, with fretfulness, wilfulness, or an uncommon mildness is present, or perhaps despondency. Some show alterations in temper, others in disposition.

(*b*) The Digestive System.—The most common disturbance, that of morning sickness, we have already discussed.

We frequently observe perversion of appetite. Entire absence of appetite or an increased demand for food is present. Some women experience what is popularly termed "longings" or "cravings." These consist in a desire for unusual, unheard-of, or even disgusting articles of food.

In the early weeks we often observe profuse salivation, pyrosis (water-brash), acid eructations, heartburn, diarrhœa, or constipation alternating with diarrhœa.

(*c*) The Circulatory System.—Here we observe symptoms due to what was at one time termed general plethora. Flushings of the face, that may be described as painful, are observed, also sensations of heat alternating with those of cold. There may even be a rise of temperature of a degree or fraction thereof.

These sympathetic disturbances are in all probability caused by reflex spasm of the smaller blood-vessels in the early months, and later by actual changes in the maternal blood itself.

3. **Rectal Disturbances.**—The sinking of the enlarging uterus in the first third of gestation may, by pressing upon the

rectum, cause irritation. Pre-existing hemorrhoids may be aggravated, new ones formed, or constipation or diarrhœa produced.

4. **Bladder Disturbances.**—For the same reason an irritable bladder may result, showing itself principally in the frequent desire to pass water during the daytime. Examination of the urine in some instances will reveal even a mild catarrhal inflammation of the bladder which causes the usual symptoms of pain, frequent micturition, tenesmus, and scalding.

Irritability of the bladder is so constant, especially in primiparæ, in the early weeks of gestation, that some authorities attach considerable importance to this symptom when associated with that of cessation of menstruation.

5. **Enlargement of the Abdomen.**—During the first two months of gestation little if any perceptible enlargement of the abdomen occurs. Indeed, the lower part of the abdomen—hypogastric region—may be even flatter than in the non-pregnant condition, due to the sinking of the uterus lower in the pelvic cavity as a result of its increased weight.

In the third month some enlargement of the lower part of the abdomen occurs.

In the fourth month the cause of this enlargement—the pregnant uterus—may be palpated.

6. **Pain.**—Pain as a symptom of pregnancy is not always present. When it does occur it is usually in the later months, and in the last fortnight is caused by the falling womb pressing upon the pelvic nerves, or upon a knuckle of intestine caught between it and the pelvic basin.

7. **Varicosities and Œdema of the Lower Extremities.**—These are mere pressure symptoms and occur late in pregnancy, are not constant, but when present cause considerable pain and annoyance to the patient.

8. **Alterations in the Skin.**—Deposit of pigment may occur in various parts of the body, as abdominal walls, face, forehead, mammæ, labia. Irregular brownish, sometimes yellowish patches often appear upon the forehead and face.[1]

Of the above the most characteristic and constant is the pigmentation upon the anterior abdominal wall. It appears early, and extends from the pubes to and around the umbilicus (umbilical areola) and still following the median line sometimes reaches the ensiform cartilage. In blondes and the red-haired this is indistinct; in brunettes most marked.[1] Seborrhœa and eczema of the face and head are sometimes seen (Spiegelberg).

---

[1] "Mask of pregnancy."

II. Probable Signs.

1. **Cessation of Menstruation.**—Usually this is the first sign of gestation. The suppression of the menses is what in the majority of cases first calls the woman's attention to her condition.

The French (Cazeaux) are accustomed to describe a more voluptuous sensation as characteristic of a fruitful cohabitation. But this sign, together with the retention of the semen after intercourse, a peculiar condition of the eyes, a swelling of the neck, as signs that pregnancy has taken place, are too uncertain to be more than mentioned.

In a female enjoying perfect health, and who has not previously suffered from menstrual derangement, the cessation of menstruation, alone or in conjunction with other uncertain signs, would render the presence of pregnancy probable. Certain conditions, however, detract from the value of this probable sign of gestation. These are three in number:

(*a*) Other causes than pregnancy may determine the arrest of menstruation. Perhaps the most common of these is taking cold. Simple wetting of the feet in some persons, as is well known, will cause an arrest of menstruation.

Mental impressions will affect the menstrual flow. In the unmarried, fear following illicit sexual intercourse will sometimes produce a suppression of one or more periods, and in the married the same cause or an intense desire for child-birth will do the same.

Tuberculosis, as is well known, is a very common cause of amenorrhœa, and debility and anæmia from other causes, as syphilis, may do the same.

(*b*) Pregnancy may take place in the absence of menstruation. Pregnancy may occur in a young girl who has never menstruated. She may become pregnant before puberty; "she may bear fruit before flowers."

---

[1] Barnes (Trans. Amer. Gyn. Soc., vol. i.) ascribes the pigmentation of pregnancy to a functional change in the suprarenal capsules. Jeannin (Gazette Hebdo., 1868) advanced the amenorrhœa of pregnancy as the cause.

Then, as is well known, gestation may occur in women during the amenorrhœa of lactation. When a woman nurses her child at the breast, menstruation is normally absent. In the majority of cases (seventy-one per cent[1]) menstruation is re-established by the end of six months from the date of confinement, and it is during this period of amenorrhœa that impregnation may and does occur.

Then there are a certain number of cases on record where women have become pregnant after apparently passing the change of life.[2]

(*c*) What is apparently menstruation may occur, with more or less regularity, through a part or the whole of pregnancy. During the first three months of gestation, before the decidua reflexa is pushed out by the swelling ovum and becomes blended with the decidua vera, these cases of menstruation during pregnancy are not difficult of explanation. After the completion of the third month, while some cases may be explained by the presence of an eroded cervix, a cervical polypus, placenta prævia, or extra-uterine pregnancy, yet a certain number cannot be so explained away.

2. **Changes in the Vulva, Vagina, and Portio Vaginalis.**—(*a*) External Genital Organs.—Some time in the first third of gestation, upon an inspection of the external genital organs, the following conditions may be found; they become more marked as pregnancy advances.

The greater and lesser labia are somewhat increased in size; they become more elastic, more resisting to touch, and in brunettes a deposit of pigment may often be seen under the skin of the external lips.

The normal red or pink color of the inner surfaces of the labia minora as pregnancy advances gives place, in some cases, to a decided blue, violet, or even purple color.

The functional activity of the glands increases as pregnancy advances, and the parts are bathed by more or less glairy mucus in consequence. Dilatation, engorgement, and even a varicose condition of the blood-vessels may be seen in the later months.

---

[1] Carl Braun: "Lehrbuch d. g. Gyn.," Wien, 1881, p. 211.

[2] Parvin: "Science and Art of Obstetrics," Phila., 1886, p. 178.

Often the tumefaction, or perhaps œdema, present in the labia causes them to separate and thus expose the entrance to the vagina to a greater or less extent.

(*b*) Vagina.—Pregnancy here causes in many instances a puffy and swollen condition of the mucous membrane, with usually an increase of the mucous secretion. The surface is often roughened by the enlarging papillæ. The temperature is increased slightly according to good authority, and the vessels may often be felt pulsating, giving rise to the term "vaginal pulse."

All of the above changes are of little significance, since all may be present under conditions other than pregnancy.

One change, however, is important and is certainly a valuable aid to the diagnosis of the pregnancy before more reliable signs are to be appreciated. We refer to the violet hue of the mucous membrane, especially described by Jacquemin and Kluge,[1] and recently carefully investigated by Chadwick.[2]

The sign is usually present as early as the second month. It is first seen as a pale violet on the anterior vaginal wall near the meatus urinarius, in contrast with the normal pinkish [illegible] advances the color deepens, in- [illegible] suggestive of pregnancy in 10, and diagnostic in one case. At the end of the third month, out of 28 cases observed, the sign was suggestive in 5, and characteristic in 11.

It will be readily seen from these investigations that the sign is not an infallible one. At the end of the third month it was not observable in 17 per cent of Chadwick's cases and in a greater proportion of those of Farlow. Other conditions, physiological and pathological, may produce appearances identical with those of gestation. Montgomery has observed the same blue color after menstruation. The writer has frequently observed the blue color just before as well as immediately after menstruation in dispensary practice. Chadwick mentions a case of erotism as causing the same discoloration. Many pathological conditions of the uterus and other pelvic organs which produce venous stasis give a blue coloration to the vaginal mucous membrane. For the above reasons we have placed this sign among the probable ones of gestation.

---

[1] Sommer: Berl. med. Central-Zeitung, Jan. 14th, 1837.

[2] Trans. Amer. Gyn. Soc., vol. ii., 1886, p. 399.

[3] *Loc. cit.*

[4] *Loc. cit.*

[5] Boston Med. and Surg. Jour., vol. cxvii., No. 3, 1887.

(*c*) Portio Vaginalis.[1]—During the early weeks of pregnancy the cervix uteri undergoes no change except, perhaps, as regards its position. We usually find it somewhat lower in the vagina at this time and more readily felt, in consequence of the increasing weight of the uterus causing that body to descend somewhat in the pelvis. We find it also deflected to the left side at this time.

By far the most important change, however, in the neck of the womb as a result of pregnancy is the change in its consistency. Early in pregnancy the cervix commences to soften from below upward, and this softening is especially marked in women who have already borne children (multiparæ), and in these the change may be appreciated as early as the sixth week. In almost all cases of pregnancy (multiparæ and primiparæ) the change can be readily made out in the third month.

The softening begins about the external os, and at first (in the early weeks) gives to the examining finger the sensation of pressing upon something hard through an intermediate soft substance, as where the surface of a table is pressed upon with the finger through a plush cover. The softening continues until by the end of gestation the whole neck of the womb is involved, and then its consistency is so similar to that of the walls of the vagina that the one is with difficulty distinguished from the other.

Goodell,[2] who attaches great importance to this change as a proof of the presence of utero-gestation, states: "When the cervix feels as hard as the tip of the nose, pregnancy does not exist, but when it is as soft as the lips, the womb most probably contains a fœtus."

---

[1] Intravaginal portion of the neck of the womb.

[2] Med. Press and Circ., Dec. 16th, 1877, p. 524.

The value of this sign, when we most need its assistance for determining the pregnancy, namely, in the first months, is of a probable nature only. Certain morbid conditions of the cervix may cause the absence of the sign in the presence of gestation; and pregnancy being absent, other morbid states may produce softening of the cervix. Among the former is hypertrophic elongation; among the latter, acute metritis, hæmatometra, and like conditions.

Shortening of the cervix during pregnancy was at one time believed to occur and to be a valuable sign of the condition. Now we know that the shortening is apparent only, observers having been deceived by the softening passing unrecognized as cervical tissue.

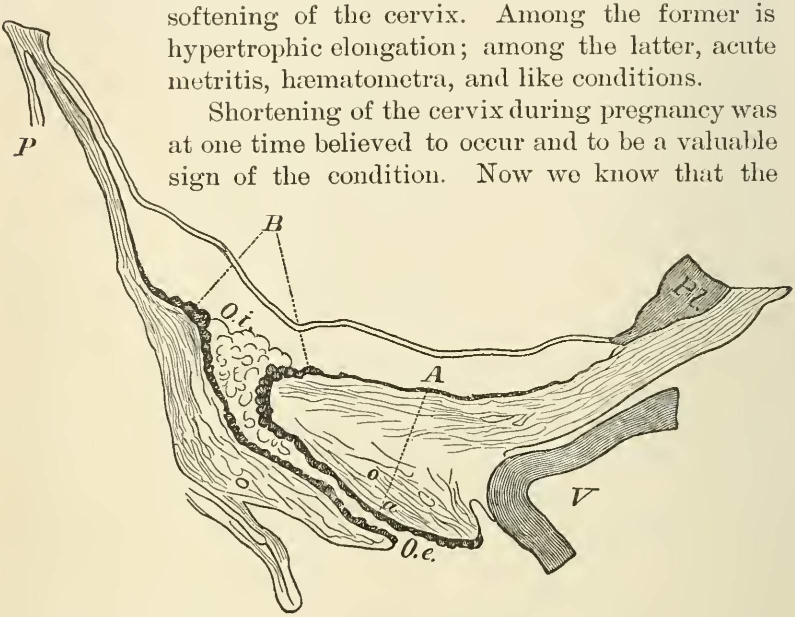


Fig. 41.—*B*, Borders of the cervical mucous membrane; *Pl*, placenta; *V*, bladder; *O.i.*, os internum; *O.e.*, os externum; *Aa*, apparent length of cervical canal on digital examination.

3. **Changes in the Size, Form, and Consistency of the Uterus. Fluctuation.**—(*a*) Size.—During gestation the uterus gradually increases in size, but it is not until the end of the third month that the fundus of the organ rises above the brim of the pelvic basin.

At the end of the fourth month it is a few fingers' breadth above the pubic symphysis.

At the end of the fifth month, half-way between the symphysis and the navel.

At the end of the sixth month, at the umbilicus.

At the end of the seventh month, half-way between the umbilicus and the ensiform cartilage.[1]

At the end of the eighth month, at the ensiform cartilage.

At the end of the ninth month (full term), same as end of seventh.

(*b*) FORM.—The normal (unimpregnated) uterus is pear-shaped, flattened from before back. Pregnancy causes it to belly out over the neck in all its transverse diameters, so that by the second month it resembles in shape "an old-fashioned fat-bellied jug" which has been inverted in the pelvic cavity.[2]

In the middle of pregnancy it is almost round, and at full term it becomes elongated again, flattened somewhat from before back.

(*c*) CONSISTENCY.—The normal (unimpregnated) uterus feels hard, resisting, non-elastic, non-compressible; resembling a mass of fibrous tissue somewhat. Pregnancy causes all this to change. Softening and compressibility commence in what is known as "the median section of the lower uterine segment."

"The compressibility of this median section is asserted to be sometimes so great that the mass of tissues grasped between the fingers seems to be no thicker than a visiting-card, or actual solution of continuity between the body of the uterus above and the neck below is apparent" (Jaggard).[3]

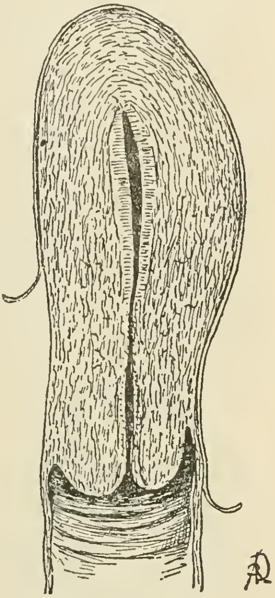


FIG. 42.—Antero-posterior Section Through the Uterus of a Woman who has Never Borne Children.

This new sign of pregnancy Hegar,[4] whose name it bears, believes to be a reliable one. The sign is valuable in early pregnancy, but sufficient time has not elasped since Hegar called attention to it to pass judgment upon its fallibility. Six cases of the diagnosis of pregnancy in the early weeks by this sign alone are reported by Reinl. Eight are recorded by Compes, and in one the diagnosis was made at the seventh week. In one case he was unable to detect it, and observed somewhat similar phenomena in cases of uterine displacement (retroversion).

---

[1] Lower end of the breast-bone.

[2] See article by R. L. Dickinson, M.D., New York Jour. Gyn. and Obstet., vol. ii., p. 544.

[3] "Amer. Sys. Obst.," vol. i., p. 355. Sonntag: Amer. Jour. Obst., xxvi., 2, August, 1892, p. 145 *et seq.*

[4] Reinl: Prager medicin. Wochenschr., 1884, No. 26.

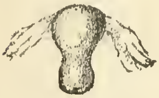


FIG. 43.—Unimpregnated Uterus (about ⅐ natural size).

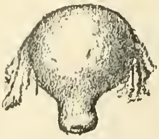


FIG. 44.—Uterus at Second Month of Pregnancy (about ⅐ natural size).

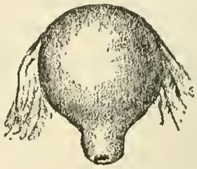


FIG. 45.—Uterus at Third Month of Pregnancy (about ⅐ natural size).

The softening continues until the whole body of the uterus is involved, and in the later months, under favorable circumstances, the fœtus itself may be felt through the walls.

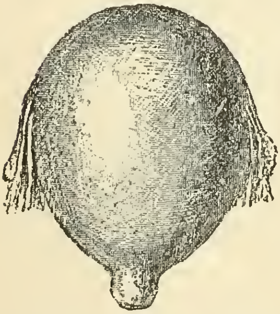


FIG. 46.—Uterus at Sixth Month of Pregnancy (about ⅐ natural size).

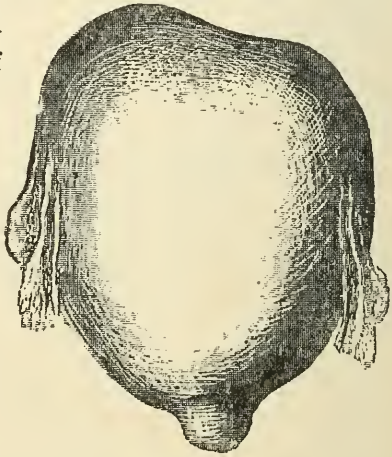


FIG. 47.—Uterus at Full-term (about ⅐ natural size).

Schroeder[1] does not hesitate to state that: "The pregnant uterus is so characteristically soft, almost dough-like, from the second to the fourth month that in cases in which this change is present in a pronounced degree pregnancy is positively demonstrated." He (Schroeder[1]) further states: "If the uterus is found, upon bimanual exploration, of a size corresponding to the period of time (end of the third month), in a position of slight anteflexion, non-sensitive, of a peculiar consistency—if the woman is perfectly healthy, and if the previous regular function of menstruation has been suppressed for a corresponding period of time—the diagnosis of pregnancy is certainly established."

---

[1] "Lehrb. d. Geburtsh.," 9te Aufl., Bonn, 1886, p. 109, quoted by Jaggard.

(*d*) FLUCTUATION.—Fluctuation may be obtained over the pregnant uterus, as in any fluid tumor, and there is nothing characteristic about the sign thus obtained, although some have laid great stress upon it as a sign of gestation.[2]

4. **Ballottement, Vaginal and Abdominal.**—Ballottement is either internal (vaginal) or external (abdominal).

From the fourth to the eighth month the fœtus floats in the liquor amnii, and passive movements may be communicated to the whole fœtus, and the appreciation of these movements constitutes the sign of pregnancy known as ballottement. Before and after the period named the fœtus is relatively too large as regards the quantity of liquor amnii to permit of the sign being made out.

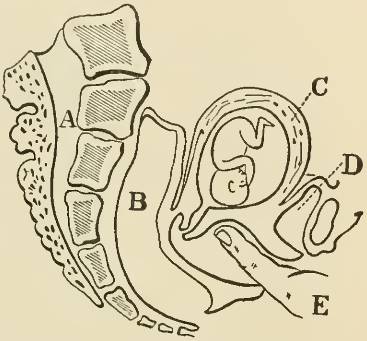


FIG. 48.—Examination for Ballottement. (King.) *A*, section of sacrum; *B*, rectum; *C*, uterus; *D*, bladder; *E*, examining finger.

Passive movements of portions of the fœtal body can, however, be appreciated until late in pregnancy when the presenting part becomes engaged in the pelvic cavity (Fig. 48).

To practise internal ballottement the woman either stands, takes the semi-recumbent or dorsal position. One or two fingers of the right hand are introduced into the vagina and applied to the presenting part of the fœtus through the anterior vaginal wall. The other hand is placed upon the fundus of the uterus through the abdominal walls. The internal fingers suddenly press up the fœtus. Its entire body is thus thrown upward and is felt by the external hand, and upon the sinking of the fœtus again by the internal fingers.

---

[1] *Loc. cit.*, p. 110, quoted by Jaggard.

[2] Rasch: Brit. Med. Jour., Aug. 30th, 1873, p. 261.

To practise external ballottement the woman is placed upon her back and a hand is laid upon each side of her abdomen. With one hand a sudden jerk is made, and the fœtus is dislodged and felt to strike the other hand, just as a lump of ice floating in a tumbler may be displaced from side to side with the finger.[1]

The sign may also be obtained by placing the pregnant woman upon her side, with her belly hanging over the edge of the bed. The fingers of one hand are placed under the abdomen, and the other hand is placed upon the upper part. "The sensation of the recession of the fœtal body and the *choc en retour* are more distinctly perceived in this position than in the former" (Jaggard).

Regarding the value of this sign of pregnancy we may state that it can only be considered a certain sign of gestation when appreciated by an expert observer.

Many consider it one of the sure signs, but so many sources of error are possible that we have placed it among the probable signs of pregnancy.

The French use this method of diagnosis and give greater significance to this sign, when elicited, than do the German, English, or American obstetricians.

"The fallacies to which the sign is liable are numerous and not unimportant. A multilocular cystoma of the ovary (Pajot), a small ovarian cyst with a long pedicle, the non-pregnant anteflexed uterus (Cazeaux), the pregnant womb itself (Robert Barnes) floating in ascitic fluid, a wandering kidney, a calculus resting in the bas-fond of the bladder (Cazeaux), have actually caused sensations analogous to those of repercussion. It is usually possible, however, to exclude these sources of error."[2]

5. **Intermittent Uterine Contractions** (Braxton Hicks' sign).—In 1871 J. Braxton Hicks[3] stated before the London Obstetrical Society that during the entire duration of pregnancy the uterus was subject to alternate contractions and relaxations,

---

[1] Tarnier.

[2] Jaggard: "Amer. Sys. Obst.," vol. i., p. 373.

[3] See also J. Braxton Hicks: "On the Contractions of the Uterus throughout Pregnancy, and their Value in the Diagnosis of Pregnancy, both Normal and Complicated." Transactions of the Ninth International Med. Congress, 1887.

at varying intervals, and claimed diagnostic value for this phenomenon.

Before the fourth month it is difficult to obtain this sign except by a very careful bimanual examination. After the fourth month, upon grasping the pregnant uterus through the abdomen, the organ will be felt to alternately contract and relax. The contraction usually lasts from three to five minutes, and the interval from five to twenty.

The value of this phenomenon as a sign of pregnancy is great. It is almost a certain sign.[1] Some class it as such.[2] To be sure, morbid conditions such as hæmatometra, physometra, soft fibroid tumors of the uterus, a distended bladder, may give the same sign; but these conditions can, with the exception of soft, rapidly growing fibroids, usually be readily excluded.

The sign is always present, even in early pregnancy. It has to do with the mother, and is entirely independent of the fœtus. The latter may be dead and degenerated without affecting the sign.

This sign is particularly valuable in cases of hydramniotic enlargement of the uterus, when it is difficult to obtain any of the certain signs of gestation, the excess of liquor amnii hiding them. Charpentier[3] reports a case where this sign alone enabled him to diagnosticate an acute hydramnios in the third month. An immediate artificial interruption of pregnancy resulted in the discharge of twin fœtuses and about fifteen quarts of liquor amnii.

6. **Uterine Murmur.**—Upon listening over the gravid uterus any time after the fifth month, and in exceptional cases earlier, a blowing sound, of variable quality and degrees of intensity, may be readily heard occurring synchronously with the maternal pulse.

This sound was first discovered by De Kergaradec in 1821, and "since that time has been successively designated placental souffle (Monod, Ulsamer, Hohl), abdominal souffle (Bouillard), simple pulsation (Ritgen), epigastric souffle (Kiwisch), and uterine souffle (P. Dubois, Dépaul, Naegele)."[1]

---

[1] "Inasmuch, however, as the intermittent uterine contractions are closely simulated by at least one morbid state, more particularly during the early months, the symptom cannot be classified among the certain signs of pregnancy" (Jaggard: "Amer. Sys. Obst.," vol. i., p. 370).

[2] Lawson Tait says, "This is an infinitely more certain sign than the fœtal heart or the sound of the placental bruit" (Trans. of the New York State Med. Ass'n, Albany, 1886).

[3] Trans. of the Ninth Internat. Med. Congress.

The sound has been heard as early as the fourth month, and its intensity is said to increase up to the end of the seventh month.[2] Of 307 women examined by Dépaul after the fifth month of gestation, he heard the uterine murmur in 295.

M. H. F. Naegele[3] found it in 580 out of 600 cases of pregnancy examined.

It is unnecessary here to go into the various theories regarding the cause of this sound. Suffice it to state that it is generally accepted as produced in the branching arteries of the uterus.

The value of this sign of pregnancy for diagnostic purposes is not great. A bruit or souffle closely resembling it is heard in certain morbid conditions independent of pregnancy, as in chronic enlargement of the uterus (metritis) and in certain uterine (myomata) and ovarian tumors.

7. **Mammary Changes.**—These changes, although in most cases they supply only presumptive evidence of gestation, are important, since not one but many signs of pregnancy may be obtained from them.[4]

A careful and systematic examination should be made with both breasts fully exposed, and the woman in the dorsal position. The changes to be noted are in the breast itself, in veins of the surface, the deposition of pigment into an areola and secondary areola, the enlargement of the glands of Montgomery, the nipple, together with secretion.

Changes in the mammæ begin with pregnancy, and at the end of gestation changes in one or more of the above situations may be noted.

At first inspection alone should be made use of, as it is quite possible by palpation to produce a physiological congestion, and thus the observer may be deceived as regards the size and firmness of the breasts.

In *inspecting* the breasts we note their enlargement which commences early in pregnancy. The superficial veins are seen to be more distinct and enlarged. These are more marked in women of a blonde type. After the sixth month stretching of the skin may cause silvery lines or striæ, similar to the lineæ albicantes of the abdomen, to appear, especially in primiparæ. Old ones appear white, new ones pinkish in color.

---

[1] Jaggard: *loc. cit.*, vol. i., p. 381.

[2] Dépaul: "Traité Théorique et Pratique d'Auscultation Obstét."

[3] "Die geburtsh. Auscult.," Mayence, 1838.

[4] "The anecdote is related of John Hunter, that on inspecting the mammæ of a young girl whose body was arranged for a post-mortem examination, he pronounced her pregnant. The hymen was found to be intact, but upon opening the abdomen the diagnosis was verified" ("Amer. Sys. Obst.," vol. i., p. 362).

Pregnancy causes a darkening in the areola about the nipple, which is more marked in women of the brunette type. The tubercles (of Montgomery) upon its surface become enlarged and prominent. At about the fifth or sixth month, about the primary areola which has a diameter of about an inch, and which commences to darken early in gestation, small white spots become visible, presenting the appearance "of dust-covered white blotting-paper upon which drops of water have been sprinkled" (secondary areola of Dubois). Montgomery attaches great weight to these spots as signs of gestation.

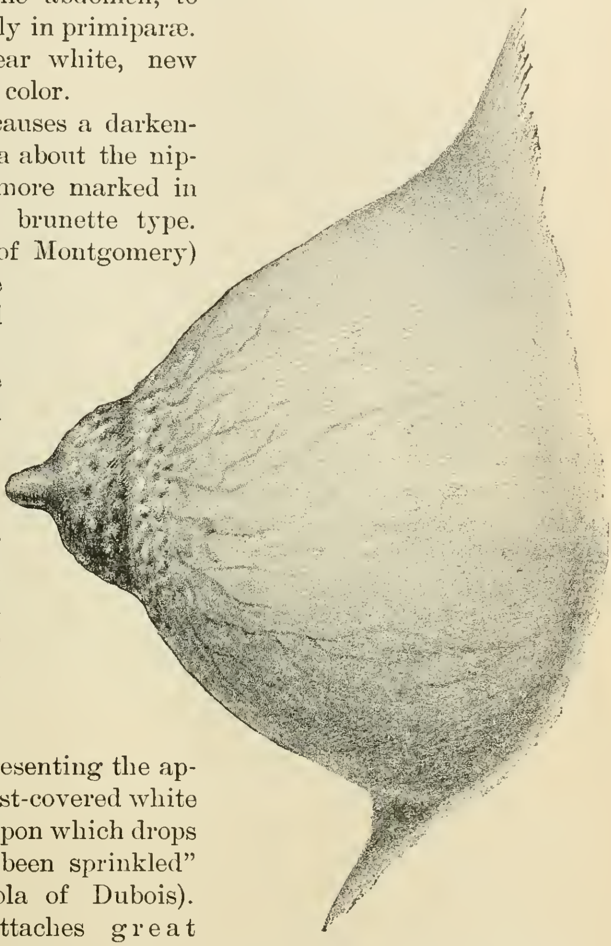


FIG. 49.—Breast of a Pregnant Woman Seen in Profile. (Ribemont-Dessaignes.)

The nipples themselves become enlarged, are harder, firmer, more sensitive, and take on erection more readily, than in the non-pregnant state. As early as the third month, upon the apex of the nipple minute branny scales may be seen, caused by the drying of the colostrum at this point. At this time also, upon careful manipulation a drop or two of a serous-like fluid can be squeezed from the nipple, which examined under the microscope may give colostrum corpuscles (see Fig. 51).

Upon palpating the breast itself it will be found harder, firmer, often painful, and more knotty, than usual—all of which changes progress with the growth of the fœtus.

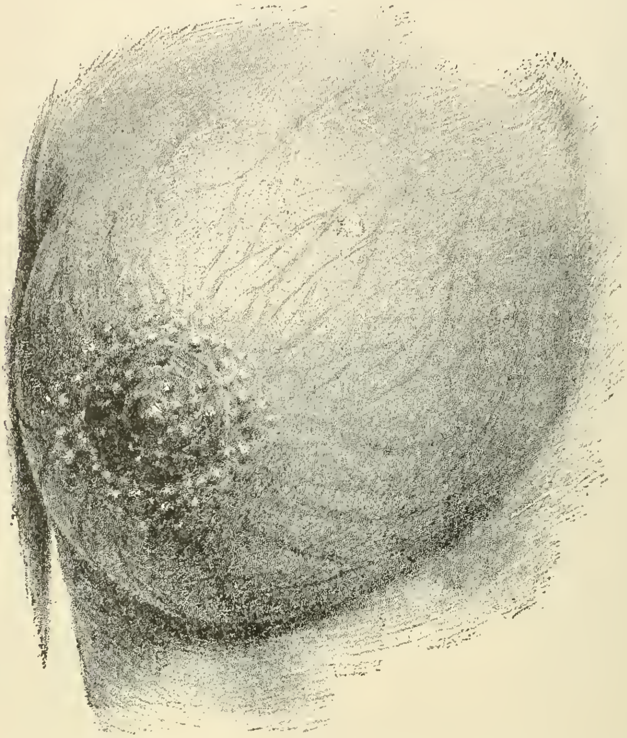


FIG. 50.—Breast of a Pregnant Woman. Anterior view. (Ribemont-Dessaignes.)

Milk does not usually appear in the breasts until labor, or even some time after; but, as already stated, a fluid known as colostrum may be squeezed out as early as the third month.

It occasionally happens that the breasts increase in size markedly up to the middle of gestation, then diminish in size and remain thus until labor occurs. Again, it is not uncommon, especially in elderly primiparæ, to observe little or no enlargement of the mammæ; and then these women are rarely able to perfectly nurse their child.

What is the value of these mammary signs of pregnancy?

The value of these mammary changes is lessened from the following facts:

1. Cases of pregnancy occur where little or no alteration takes place in the breasts until after labor, and in some instances not even then.

It is not uncommon to observe cases of pregnancy with little or no alterations and no secretion during or after gestation. Again other cases occur where there is no secretion while the woman is carrying her child, but a short time after labor a normal secretion is established.

As already stated, the breasts often, after the middle of pregnancy, diminish in size.

As is well known, impregnation may occur during lactation when the alterations already referred to, and the lacteal secretion, are present.

2. Mammary changes, together with the secretion of milk, occur independent of pregnancy.

Well-authenticated cases of milk in the male breast have been recorded (Humboldt).

What is apparently colostrum has been frequently observed in the breasts of infants and very young children; this secretion being entirely independent of sexual excitement. Faye[1] examined 120 infants and found a secretion in the breast of all but 6; of these 4 were boys and 2 girls.

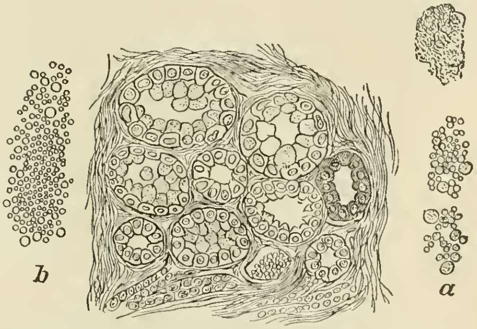


FIG. 51.—Mamma in Lactation, × 330. *a*, colostrum; *b*, milk. (Winckel.)

Milk has been secreted by the breasts of unmarried and non-pregnant women.

"Baudelocque presented to the Academy of Surgery of Paris in 1783 a female child eight years old who had suckled a little brother for more than a month."[1]

---

[1] London Med. Record, Oct. 15th, 1877, p. 413.

Tanner states that "it is not uncommon to western Africa for young girls who have never been pregnant to regularly employ themselves in nursing the children of others, the mammæ being excited to action by the application of the juice of one of the Euphorbiaceæ."

It is common for sexual excitement and mechanical irritation of the breasts among nulliparous prostitutes to produce a secretion of colostrum from the mammæ.

8. **Changes at the Umbilicus. Striæ.**—The umbilical depression is somewhat increased or unchanged in the first third of pregnancy. During the following months it gradually disappears until in the last two there is a protrusion of the umbilicus ("pouting of the navel").

Usually in the first pregnancy, sometimes in subsequent ones, striæ, cicatrices of pregnancy, silvery lines, striæ gravidarum, or lineæ albicantes, appear upon the lower part of the abdomen late in pregnancy as the result of pressure, and occasionally upon the thighs and hips. Recent or new ones appear bluish-red or pinkish, old ones pearly or whitish. They are absent in from six to ten per cent.[2]

III. CERTAIN OR SURE SIGNS OF PREGNANCY.

1. **Palpating the Fœtus Through the Uterine Walls.**—"It is the most certain of all, because it is always appreciable; even in commencing abortion embryo or fœtus may be felt in utero, or in the case of a dead child, when all other sure signs fail."[3]

As early as the fourth month it is sometimes possible to feel the fœtal head through the anterior vaginal wall.[4]

This sign possesses its greatest value in the hands of those who have accustomed themselves to fœtal palpation. In the hands of the inexperienced many mistakes are liable to occur. Fibroids of the uterus, malignant diseases of the omentum and peritoneum, "and multilocular cystomata of the ovaries, especially in the presence of ascitic fluid, may closely simulate to the sense of touch the head, pelvis, and particularly the upper and lower extremities of the fœtus."[1]

---

[1] "Amer. Syst. of Obstetrics," vol. i., p. 36.

[2] Hecker found them absent in six per cent, Credé in ten per cent; Schultze found them in thirty-six per cent of nulliparous women.

[3] Winckel: "Text-Book of Obstetrics," American edition, Phila., 1890.

[4] Carl Braun: "Lehrbuch d. g. Gyn.," Wien, 1881, p. 211.

Indeed, Winckel himself, who attaches such importance to this sign, narrates an instance where a physician mistook the fœtal head for a hæmatocele.[2]

2. **Fœtal Heart Sounds.**—The sounds of the fœtal heart constitute a certain sign of gestation when clearly heard and carefully compared with the maternal pulse and also that of the examiner.

The writer has not placed this positive proof of pregnancy first, because in the case of a dead fœtus, of course, the sign would be absent.

The sounds of the fœtal heart have generally been compared to the ticking of a watch under a pillow. The beat is distinctly double—a first and a second sound—with an interval between two separate pulsations twice that between the two parts of the pulsation, *i.e.*, between the first and second part.

HOW EARLY MAY THE FŒTAL HEART SOUNDS BE DISTINGUISHED?—Obstetric authorities are generally agreed that the sounds of the fœtal heart are usually first heard between the eighteenth and twentieth week of pregnancy. Under favorable circumstances they may be heard at the fifteenth or sixteenth week and exceptionally still earlier.[3]

Dépaul[4] states that he has recognized the fœtal heart sounds at the eleventh week; Tarnier, at the twelfth; and Routh and Verandini, using the vaginal stethoscope, at the twelfth week.

When once distinguished, they are usually heard with increasing intensity during the remainder of pregnancy.

Of 906 women examined by Dépaul[5] in the last third of pregnancy, these sounds were absent in only 8 instances. Of 180 women examined by Anderson of Glasgow, during the same time, the sounds were not heard in 12 cases, and these subsequently proved to be still-born children.

In exceptional cases the sounds have been inaudible throughout pregnancy, and yet labor at term has resulted in the birth of a vigorous child.

---

[1] Jaggard: *Loc. cit.*, vol. i., p. 374.

[2] *Loc. cit.*, p. 108.

[3] Jaggard: *Loc. cit.*, vol. i., p. 375.

[4] Dépaul: "Traité Théorique et Pratique d'Auscultation Obstét."

[5] *Loc. cit.*

With what may the fœtal heart sounds be confounded?

The most frequent mistake is to take the pulsations of the woman's heart for those of a fœtus. Cases are on record where this has happened, and an abdominal tumor pronounced to be the pregnant uterus.[1] The observer's own cardiac pulsations may also deceive him. Mistakes are avoided by carefully observing that the fœtal heart sounds are not synchronous with either the woman's or the observer's.[2]

This is another sure, certain, positive sign of pregnancy. It is generally held to be more certain than any other single sign or combination of signs. The recognition of the sounds by a competent observer proves beyond a doubt both that pregnancy exists and that the fœtus is alive. "Their absence, however, does not warrant the assumption that pregnancy does not exist or that the child is dead."[3] As has been shown, it is only in exceptional cases of pregnancy in the later months that these fœtal heart sounds cannot be appreciated.

3. **Movements of the Fœtus.**—Upon applying the ear or stethoscope over the pregnant uterus it is possible to distinguish the sounds caused by the entire fœtus being displaced within the uterine cavity (general movements) or by the movements of the head or extremities (partial movements).

The sound produced by the total displacement of the fœtus can in some instances be distinguished as early as the third or fourth month of pregnancy. Toward the latter part of gestation the sounds become more evident and frequent,[4] and are heard most distinctly at the upper part of the uterus. This phenomenon constitutes the *bruit de choc fœtal* of Pajot.

Two sensations are appreciated—a slight gentle and sudden

---

[1] Winckel, "Text-book of Midwifery," Phila., 1890, p. 109.

[2] "These sounds (fœtal heart sounds) are distinguished from those of the maternal heart, usually, by their frequency; also because there is a certain pause between them, and moreover because the intensity of the maternal heart increases from below upward, while the fœtal sounds are more distinct from above downward. It is well to note this, as in pathological conditions the frequency may be the same in both, or the fœtal sounds may even be less frequent than those of the mother, or, *vice versa*, the fœtal heart may continue to contract as usual, although the maternal pulse rate is exceedingly high" (Winckel: *Loc. cit.*, p. 90).

[3] Jaggard: *Loc. cit.*, vol. i., p. 380.

[4] Winckel counted eighteen in one minute; *loc. cit.*, p. 92.

bruit (the sound of the child's movement), and a dull sound or shock, not unlike the shock of the aorta—the impact of the whole or a part of the fœtus against the uterine wall.

Pajot claims for this sign that in the early weeks it is more easily appreciated than the fœtal heart sounds, and in some instances may be recognized before that sign.

In the early months this sign is of great value, but only in the hands of an experienced auscultator; in late pregnancy we have so many better and surer signs that this one ceases to be of value.[1]

4. **Umbilical Murmur.**—The fœtal, umbilical, or funis murmur or souffle is a short blowing, whistling, or cooing sound, synchronous with the fœtal heart sounds, that in a certain proportion of cases is heard over the pregnant uterus.

Massmann,[2] Ahlfeld,[3] and Bumm[4] believed that the sound occurred in the fœtal heart itself; Hecker[5] and Schroeder,[6] that it was produced in the umbilical region of the child; Bumm[7] and Pinard[8] that certain conditions of the vessels of the cord accounted for the sound.

In reviewing the whole subject Winckel[9] comes to the conclusion that "the sound must be produced, as a rule, in the umbilical vein."

This sign is not a constant one of pregnancy by any means, which fact lessen its value as compared with that of the fœtal heart sounds. Hecker[10] and Schroeder[11] found it present in fourteen to fifteen per cent of cases, and these figures agree with those of most authorities upon midwifery.

---

[1] Sounds and noises heard over and about the pregnant uterus: 1. Uterine bruit. 2. Murmur in the inferior epigastric artery. 3. Intestinal sounds. 4. Maternal heart sounds. 5. Pulse of the aorta. 6. Vesicular murmur of the woman. 7. Friction sounds between uterus and abdominal walls. 8. Crepitating sounds due to the pressure of gases in the uterine and abdominal walls. 9. Blowing sounds in the uterus, due to putrefaction of child and development of gases. 10. Fœtal heart sounds. 11. Umbilical souffle. 12. Movements of child. 13. Sucking sounds (child's mouth). 14. Cry of fœtus (vagitus uterinus).—Winckel.

[2] Massmann: Monatschr. f. Geburtsk., iv., 81.

[3] Ahlfeld: "Berichte und Arbeiten."

[4] Bumm: Archiv f. Gyn., xxv., 177.

[5] Hecker: "Klinik der Geburts.," p. 27.

[6] Schroeder: "Schw., Geb. u. Wochenb.," p. 17.

[7] Archiv f. Gyn., xxv., 177.

[8] Pinard: Archiv de Tocol., 1876, p. 310.

[9] "Text-Book of Midwifery," Amer. ed., Phila., 1890, p. 92.

[10] *Loc. cit.*

[11] *Loc. cit.*

Since this sound is present in only a small proportion of pregnancies, since an experienced auscultator is necessary for its detection, and since, when present, the fœtal heart sounds are also present, its value as a sign of gestation is not great.[1]

Miscellaneous and Popular Signs of Pregnancy.

1. Enlargement of the thyroid gland.
2. Turning out of the toes—the woman thereby increasing her base of support.
3. A more erect attitude, with shoulders thrown back and abdomen forward, in order to better balance herself.
4. An appearance of well-being.
5. Kiestein or gravidin in the urine (utterly worthless; found in the urine of the male).
6. Cardiac hypertrophy, and stronger pulse.
7. Albumin and sugar in the urine.
8. Vertigo, syncope, tendency to faint.
9. Headache, occipital in character (test of Beccaria).
10. Temporary amaurosis, caused by anæmia of the optic discs and retina.
11. Pigmentation on the face and arms.
12. Diarrhœa, frequent micturition, salivation, alterations in character, temper, and appetite.

ILLUSTRATIVE CASES OF THE DIAGNOSIS OF PREGNANCY.

1. *Levy: Arch. f. Gyn., xv.*, 3, *p.* 361, 1880.—Cases of menstruation during pregnancy.

2. *Henke's Zeitschr. f. St. Arzneik.*—Fifty cases of menstruation during pregnancy reported by Elsässer. Two of these fifty menstruated nine times. Author concluded that the condition was not true menstruation, but a pathological hemorrhage.

3. *Maré, Leon: L'Union médicale, xxxvi.*, 47, *p.* 558, 1882.—Some time after the birth of a child menstruation sets in and continues for four months and then ceases; child meanwhile suckled; two months later woman is found in her sixth month of pregnancy, that is, she has menstruated while suckling a child, and while pregnant with a second one.

---

[1] For the pathological significance of this murmur see: Winckel: "Zur Path. der Geb.," p. 223; "Text-Book of Midwifery," American edition, Philadelphia, 1890, pp. 92, 345, 354, 352, 366, 896.

4. *Oliver, J.: Lancet, London*, 1890, *i.*, 596.—Menstruation twice after conception, and colostrum on the 97th day in a primipara.

5. *Farrar: London Lancet, Dec. 12th*, 1874, *p.* 853 (recorded by Tidy, "Med. Jurisp.").—Female, æt. 7 years. Both breasts contained milk. Each gland measured two inches in diameter, and was considerably elevated.

6. *Jackson, Edwin: London Lancet, July 6th*, 1873, *p.* 34 (recorded by Tidy, "Med. Jurisp.").—Lactation in a female child æt. 8 days. About a teaspoonful of milk (?) was drawn from each breast on two successive days.

7. *Brit. Med. Jour., Jan. 1st*, 1876.—Milk secretion in a bitch nine weeks after being in heat. At the time she was not in heat.

8. *Havard, V.: New York Med. Jour., ix., p.* 440.—Cases of milk secretion in new-born children.

Parvin ("Science and Art of Obstetrics," Phila., 1886) gives some curious cases that have come under his observation as illustrative of the cautiousness and deliberateness the diagnosis of pregnancy demands :

9. "A young lady of high social position, and against whose purity there was no whisper or thought of scandal, is attacked with obstinate vomiting. There is a denial of menstrual derangement; the vomiting resists all remedies, and she dies, but while dying a fœtus of three months and a half is expelled.

10. "A woman having passed twenty years of married life childless, some months after the menopause becomes pregnant; the pregnancy is suspected by one attendant, and denied by another.

11. "A girl who has never menstruated, and who does not fully present the other signs of puberty, becomes pregnant by violence, and gives birth to a child when she is twelve years old.

12. "A woman has menstrual suppression, coincident abdominal enlargement, the mammary and many signs of pregnancy ; but a post-mortem examination proves cystic disease of the ovary.

13. "A girl of twenty has never menstruated ; her abdomen enlarges, her breasts are swelled and secrete ; after a time severe uterine contractions occur, and a physician of large experience called to her during this attack declares she is in labor ; the cause of the abdominal enlargement is accumulation of many months' menstrual secretion, and the uterine contractions simulating labor pains are the efforts to overcome the resistance of an imperforate hymen."

14. Pajot[1] relates a case where a pregnant uterus of four months was mistaken for an abscess and opened with the knife by a man held to be learned in his profession.

Tardieu[2] has asserted that the abdominal signs, the mammary changes, apparent fœtal movements, and efforts of labor, in fact, all the signs of pregnancy, may be observed, with one exception, and that is, the fœtal heart sounds, in the non-pregnant woman.

---

[1] "Travaux d'Obstétrique et de Gynécologie."

[2] "Sur les Grossesses Fausses et Simulées."

II. FEIGNED PREGNANCY; FEIGNED LABOR; FEIGNED LYING-IN STATE; SIGNS OF RECENT DELIVERY IN THE LIVING; SIGNS OF RECENT DELIVERY IN THE DEAD; CORPUS LUTEUM.

1. Feigned Pregnancy. Pseudo-Cyesis.

Pregnancy, for various reasons, may be feigned or simulated. Suits for damages or to compel marriage are frequently brought, and it then becomes the duty of the physician to render a decision in the case.

The pregnancy may be purposely feigned or simulated, or the woman in question may really believe herself to be pregnant. The latter condition is one well recognized in obstetric medicine and constitutes what authorities variously term false, spurious, or nervous pregnancy.[1]

In cases of feigned or simulated pregnancy a physical examination immediately removes all doubt. For although the woman may simulate many of the doubtful signs of pregnancy in her attempt to deceive, yet an examination of her person by the physician reveals none of the probable or sure signs, and the uterus is found of normal size.

The condition is observed in women who are advanced in years; in those who expect or have an intense desire to become pregnant; in women who marry late in life and are anxious to prove their power of reproduction. Most frequently we observe the condition in the woman who is approaching her menopause, when her menstrual flows have become scanty or have ceased for a time altogether, and a deposit of fat takes place in her anterior abdominal walls, and her intestines become distended by flatulence. In such a case many of the doubtful and some of the probable, but none of the certain signs of pregnancy are present.

For example, menstruation may cease, the mammary signs of gestation appear, even to the secretion of colostrum or milk; the abdomen becomes progressively more prominent; the woman assures her physician that fœtal movements (quickening) are present; and this may all end in what is termed spurious labor.

---

[1] Pseudo-cyesis.

"The climax of the delusion of spurious pregnancy may be a spurious labor."[1]

The diagnosis of the condition is not difficult. Above all the physician should be on his guard against accepting any statements the patient may offer in regard to her condition, and in expressing an opinion to rely only upon the exclusion of the probable and certain signs of gestation, which he does by a careful physical examination of the woman.

2. Feigned Delivery.

From a variety of motives, as for extorting damages or charity, compelling marriage, disinheritance, obtaining admission into some charitable institution, or for no assignable reason women will simulate or feign delivery of a child.

A careful medical examination of these cases, if the simulated delivery is said to be recent, and if the various doubtful, probable, and certain signs of recent delivery are excluded, will clear away all doubt.[2]

T. Kost[3] says: "Testimony is sometimes required in cases of suits brought for compelling marriage or for damages, and court orders or writs of *de ventre inspiciendo* may need to be obeyed; sometimes, also, out of court, in cases of persons applying for charity to a corporation or trustees of charitable institutions. In neither of these latter cases is it likely that a witness will be required to make a vaginal examination, or to specialize by tact in any way, for there is no compulsion as in cases of the court. Nevertheless the physician may be consulted in such cases, and it will be expected that he is intelligent in such matters; if he is not, it will prove to his detriment."

---

[1] Parvin: "Science and Art of Obstetrics," Philadelphia, 1886. This author quotes the following: "Overfed bitches, which admit the dog without fecundation following, are nevertheless observed to be sluggish about the time they should have whelped, and to bark as they do when their time is at hand, also to steal away the whelps of another bitch, to tend and lick them, and also to fight fiercely for them. Others have milk or colostrum, as it is called, in their teats, and are moreover subject to the diseases of those which have actually whelped" (Harvey on Conception).

Professor Haughton reported to the Dublin Obstetrical Society (February 7th, 1880), an interesting case of phantom tumor observed in an ass that had been covered by a zebra; the appearance of pregnancy deceived an expert.

[2] See Signs of Recent Delivery, p. 341

[3] "Text-Book of Medical Jurisprudence for Medical and Law Colleges," Cincinnati, 1885, p. 189.

ILLUSTRATIVE CASES OF FEIGNED PREGNANCY, LABOR, AND THE LYING-IN STATE.

1. *Metzlar, C.: Nederl. Tijdschr. v. Verlosk. en Gynaecol., Haarlem*, 1889, *i., pp.* 87–90.—Contribution to the knowledge of the origin of phantom tumors and nervous pregnancy.

2. *Nicoll, H. D.: Amer. Jour. Obstet., New York*, 1889, *xxii., pp.* 160–166.—A case of phantom pregnancy.

3. *Madden, T. M.: Amer. Jour. of Med. Sciences, Phila.*, 1890, N. S., c. 26–30.—On false pregnancy.

4. *Segur, G. C.: Amer. Jour. Obstet., New York*, 1890, *xxiii., pp.* 449–469.—The diagnosis of pregnancy.

5. *Cunningham, J. L.: Texas Courier-Rec. Med., Dallas*, 1890–91, *viii., pp.* 64–67.—Phantom tumor simulating pregnancy.

6. *Demange, E.: Mém. Soc. de Méd. de Nancy* (1888–89), 1890, *pp.* 34–37.—Milk secretion during a "nervous" pregnancy.

7. *Goodell, W.: Medical News, Phila.*, 1890, *lviii., pp.* 409–411.

8. *Wharton and Stillé, fourth edition, vol. iii., sec.* 37, quote the following case from *Henke's Zeitschrift, vol.* xliv., *p.* 172: "Dr. Albert relates that he was called upon to see a poor girl of twenty-two years of age in her last illness. In the presence of the physician and clergyman of the district she gave the following narrative and confession. Some eighteen months previously she entered the service of a married couple as housemaid.

"Her master, who was young and handsome, and assumed the title of baron, had no children. He succeeded, by tempting presents, in overcoming her virtue.

"He then represented to her that an important inheritance depended upon his having an heir; but having been married five years, and his wife proving unfruitful, he had no longer any hope of having children by her.

"He then proposed to the girl that in case she should prove with child, and would allow him to cause it to appear as his own legitimate offspring, he would not only give her a considerable sum of money, but would also let her remain in the house of her mistress, in order that she might always be near her child.

"She accepted the proposal, and as soon as she found herself to be pregnant the preparations were made to carry out the projected imposture. The girl remained in the house, living in the most retired manner, while her mistress played the part of a lady in an interesting condition. She introduced wool and folded napkins under her dress: and thus gradually let her rotundity become apparent, rubbing her breasts frequently in order to develop them, fainted in church, was often ailing, and sent for midwives and consulted them concerning her symptoms; physicians were also called upon, and every means taken to make public her happy expectations, so that no one had any suspicion that she was not pregnant. The traces of her monthly sicknesses were carefully concealed.

"The foregoing is a good illustration of the means carried out to simulate pregnancy; then follows the more difficult task of feigning labor and delivery.

"At last in due time the young girl fell in labor, which was allowed to advance considerably before the midwife was sent for.

"In the mean time the bed was arranged in the following manner. A board was taken out of the bottom of the bedstead, and immediately above this opening a hole was made through the mattress and paillasse, large enough to allow the legs of a person to pass through and rest upon the floor. The bed was made in such a manner as to sink down toward the headboard, while it was elevated below the opening in the mattress.

"The mistress now leaned in a sitting position, with her legs through the opening in the bed, and supported against the headboard, while the servant lay across her lap on a feather-bed, in the attitude of labor. Her body was entirely concealed by the bed-coverings, which also concealed her mistress up to the neck.

"The midwife, upon her arrival, found the baroness, as she supposed, in the throes of labor; she made the necessary examination, promised a speedy deliverance, and gave the usual words of comfort. The lady, however, screamed lustily at every pain, the approach of which she became conscious of by the involuntary contractions of the poor girl's body; while the latter suppressed her cries as much as possible, except when she could mingle them unperceived with those of her mistress.

"A living male child was soon born, and the after-birth followed it immediately. While the nurse was busy washing and dressing the child in another room, the girl escaped from the bed into an adjoining chamber.

"The baroness, before the return of the midwife, drew her feet up from the opening, covered it over with the bed, and stretching herself out upon it, forbade the midwife (who was desirous of ascertaining her condition) to touch her, except to wash off the blood with which she had previously soiled her thighs, declaring that she was in so much pain that she could not endure the slightest touch.

"The child was baptized, and on the second day put to the breast of the lady.

"As, however, very naturally, it found nothing there, the midwife was discharged, on the pretext that the baroness' own attendant could now take care of the child, which, immediately upon her departure, was confided to its own mother.

"The remainder of the girl's history, not being essential here, is omitted.

"Unexplained circumstances prevented the fraud from succeeding. The authors of the conspiracy fled, leaving the servant-girl sick and in a state of destitution. She died from the effects of privation and exposure, shortly after having made this confession."

9. *Madden, T. M.: Provincial Med. Jour., vol. xi., March*, 1892. —Spurious, feigned, and concealed pregnancy.

10. *Underhill, J. W.: Amer. Jour. Obstet., xi.*, 1878.—Feigned and false pregnancy; pseudo-cyesis.

11. *Madden, T. M.: Proc. Dublin Obstet. Soc.*, 1872–72, *xxxiv.*, 63–79 (reprint).—On spurious, feigned, and concealed pregnancy.

12. *Török, J.: Pest. Med. Chir. Presse, Budapest*, 1883, *xix.*, 1891. —Medico-legal case. Concealed pregnancy. Premature, difficult labor, provoked by unknown cause. Presentation said to be breech.

13. *Fischer, C.: Zeitschr. f. Wundärzte u. Geburtsh., Hegnach*, 1887, *xxxviii.*, 264–268.—Ein forensischer Pseudo-Geburtsfall.

14. *Hauck: St. Louis Weekly Med. Review, Jan.* 10, 1891.—In this case vomiting, peristalsis, and flatus, due to alcoholism, were supposed to be caused by the pregnant state.

15. *Haultain: Amer. Journ. Med. Sciences, Phila., April*, 1891. —Reports three cases of pseudo-cyesis. No cause could be found in the first; cancer of the uterus was the cause in the second; while a small fibroid in the uterine wall was the cause of the last. He attributes the origin of the condition to nervous influences, the phenomenon being simply a muscular distention of the abdomen. Some of the other signs are not so easily explained, but in nervous origin will usually be found the cause.

16. *Sligh, Physician and Surgeon, Detroit, U. S. A., vol. xv., No. II., p.* 61.—A case of spurious pregnancy and spurious labor. Mrs. B., American, primipara, 31 years of age, brunette, nervous temperament, and of average good health, in February, 1892, informed me that she had missed her monthly flow for the last two months, and asked if I thought she was pregnant. I replied that it would be difficult to determine positively at that time, and it would, therefore, be better to wait until such time as she could determine for herself. About the 1st of May following, an addition to her house was being built and the new portion being painted, at which time she wrote me a note saying she was not very sure that she was pregnant, and asked if the smell of fresh paint would do her any harm. On July 6th, 1892, I was sent for, and on arrival at her home, a few miles distant, I found her in bed, flowing slightly, with slight inter-

mittent pains, and somewhat nervous from fear of an impending miscarriage. She informed me that a few hours previously she had started to flow, the blood coming with a gush and in considerable quantity, and that she was about six months pregnant, she having felt motion for six weeks or more. With right hand I made a digital examination per vaginam, finding neck of womb about normal in size, but softer to the touch than in a non-pregnant uterus, and my left hand on her abdomen, which was noticeably larger than usual, felt plainly, as I supposed, motions of the fœtus. I said to her that from the condition of the neck of the womb she could not be more than four and one-half or five months pregnant, and that she must have been mistaken in her statement of having felt motion nearly two months. She reaffirming her statement in this regard, I made further examination per vaginam, finding the uterus enlarged antero-posteriorly, and attempted an examination through the abdominal walls by palpation, but owing to their extreme thickness, five or six inches at least, I could determine nothing definitely, except that fœtal motions were plainly felt. I did not further examine her, as from her statements at this time, and previously, I had no doubt of her being pregnant, but had examined her to the extent related, simply to arrive at some conclusion as to how far along she was. The flowing having about ceased, I prescribed an anodyne, with rest in bed, promising to see her next day, which I did, finding that her pains and flow had ceased, and she feeling quite cheerful.

On July 9th I was again sent for, and found about the same conditions as on July 6th. No examination was made at this visit, but a similar prescription as on July 6th was left. On the evening of July 10th I was summoned in haste, and on my arrival found that an hour or two before, she had again commenced to flow, the blood coming with a gush and in considerable quantity, and pains occurring every three or four minutes, simulating labor pains. She informed me that motions of the child had been particularly strong that day, and she was very certain that a miscarriage must take place. I was also of that opinion, and having made up my mind that there was a placenta prævia, I thought it best to expedite matters, but found that I had in my obstetric bag only a light uterine dilator, and could not make full dilatation and deliver at once, as I wanted to, so I concluded to make a slight dilatation and tampon, trusting to the pains thus stimulated to complete the labor, which I at once proceeded to do, in addition thereto administering one drachm of fluid extract of ergot. Pains not increasing within an hour, I repeated the dose of ergot and went to bed, leaving instructions with the nurse to call me should the pains become notably stronger and more frequent, or should blood show through the vaginal tampon. I slept until morning, when I found the patient feeling well, the pains having stopped about an hour after I had retired. Upon removal of tampon the small amount of blood thereon showed that flowing must have ceased soon after its introduction. I was somewhat astonished at the unorthodox manner in which the case acted, but not enough so, as subsequent events proved, and returned to my office. When I arrived there I informed my assistant that I had discovered a new method of preventing miscarriage, namely, to dilate the neck of the uterus and tampon the vagina. Even now I did not suspect that she was not pregnant, with placenta prævia complicating. Before leaving her, I informed her that she had a placenta prævia, and advised immediate delivery, on account of the distance she was from any physician, but she declined this, being a Catholic, preferring to take the risk of her own life rather than possibly sacrifice that of the child.

Soon after this I went East, and did not see her again until November, 1892, when she informed me that about September 1st she went to a small town about five miles from her home, so as to be near a physician at her confinement; that at that time (September 1st) her breasts were large and milk came from the nipples; that soon after arriving at said town she had some pains and sent for a physician, who proceeded to make an examination, upon concluding which he informed her that she would be confined in ten or twelve days; at the expiration of the time he assured her she would be confined, pains came on, strong and regular, and the physician was again sent for, and after a prolonged examination, including introduction of sound into womb, he told her she was not pregnant. Soon after this she returned home, and the abdominal tumor subsided. At the present time she is fairly well, excepting an absence of menstruation probably due to her obesity, for which I am now treating her.

Here is a report of an interesting case of spurious pregnancy and spurious labor, the first I have met with in an experience of several hundreds of obstetrical cases, and I bring it to your notice, not in applause of my own acute powers of diagnosis, nor in an attempt to show that the true condition might not have been detected, had proper care been exercised on my part, but rather because of the rarity of such cases, and also as tending to prove the assertion at the beginning of this article, that "It is very hard to displace an impression once gained." It may also serve another purpose, namely, to put you on your guard against a similar mistake, and the subsequent mortification of hearing that some smart doctor, whose want of experience is equalled only by his want of knowledge, has been explaining to his friends that he, nor any other really good practitioner like himself, would ever be caught like that. Another feature of great interest in this connection is the fact that a sister of Mrs. B., who lives in Asia Minor with her husband, who is a practising physician there, went through a spurious pregnancy and spurious labor at the same time as did Mrs. B., with symptoms almost identically the same, placenta prævia being diagnosed by her husband in June, 1892, and neither of the sisters knew of the supposed pregnancy of the other until about the 1st of July, 1892.

A short time ago I requested Mrs. B. to give me a statement in writing of her supposed pregnancy, which she kindly consented to, and I herewith append a copy of her letter, omitting her residence and name :

COPY OF MRS. B.'S LETTER.

December 5, 1892.

DR. SLIGH, GRANITE, MONTANA :—The facts of my case are as follows : The last time I had my monthly period was the last of December a year ago. I missed it three times, when I consulted you as to whether I was in the family-way. You made no examination but said I could tell myself very soon. About the last of April or the first of May I felt a motion, and wrote you asking if it was safe to stay in a room where they were painting. I felt no doubt, as I was growing quite large and the motion was as distinct as with my first child. The first week in July I commenced flowing ; it came in gushes, dark, almost black in color, and was quite profuse. I sent for you and by your advice went to bed and took medicine to stop the flow, with, however, no effect. You finally pronounced it placenta prævia; you then dilated the womb and gave me ergot to induce labor pains. The flowing ceased and no pains followed, so you concluded to do nothing further at that time. In a week I started flowing again, it lasting one week. I stayed in bed two weeks. After getting up I did not flow again. My breasts grew and secreted milk, and before subsiding my waist measured forty-two inches, twelve inches larger than natural. You then left and I went to a town situated in the vicinity to be near a doctor. There I felt well and had no trouble except something like labor pains ; the doctor thereupon made an examination and said I would be sick in ten or twelve days. At the end of that time I had severe pains. I sent for the doctor, who, upon examination, found I was not pregnant at all. The next morning I returned home, and in less than a week my waist measured thirty-four inches ; the milk left the breasts, and all other signs disappeared. My sister living in Turkey in Asia, and whose husband is a physician, had the very same experience at the very same time.

MRS. B.

3. SIGNS OF RECENT DELIVERY.

The questions of interest in this connection are:

What sign or signs render the diagnosis of a recent delivery positive?

How long after the emptying of the uterus can such a positive diagnosis be made?

The legal physician is required to render a decision, not only in the case of the living, but also in the dead must he from signs present state whether or no a recent expulsion of the contents of a pregnant uterus has taken place.

In the first instance (the case of the living) the decision is reached by the usual methods of diagnosis—inspection, palpation, percussion, and so on; in the case of the dead the value of an additional sign must be weighed and decided upon, namely, the corpus luteum.

a. **In the Living.**—As in the diagnosis of pregnancy, so in the determination of the existence of a recent delivery in the living, there are a large number of signs of greater or less value. We are able to place these signs in three classes indicative of their relative value.

There are several doubtful or uncertain signs that are of little value when standing alone, for they may even be found to be present in the male.

A second class of signs, uncertain still, we can for convenience term doubtful signs, and they, as in pregnancy, have to do with changes wrought in the external and internal genital organs of the woman.

Still a third class we have, constituting the sure or positive signs, and these are all founded upon the finding of the remains of an ovum in the genital tract.

1. UNCERTAIN SIGNS.—The skin of the anterior abdominal walls is examined, and there may or may not be changes present, according as the pregnancy has been well advanced or not.

If pregnancy terminated in the first third of its existence, little more than the usual slight pigmentation from pubes to umbilicus or ensiform appendix will be found, and this in blondes may be so slight as to escape notice.

Termination of pregnancy in the last third leaves a relaxed, wrinkled condition of the abdominal walls.

Œdema of the skin and old and new striæ[1] may or may not be present, according to circumstances. A varicose condition of the veins of the legs, with or without œdema, may also exist.

Even after abortion at the fourth month the slow puerperal pulse may be found.[2]

The usual subjective symptoms, as painful micturition,

---

[1] Skin cracks, lineæ gravidarum.

[2] Vejas: Volkmann's "Sammlung klin. Vorträge."

"after-pains," thirst, burning pain in the genitals, pain in the breasts, profuse sweats, and a desire for sleep and quiet must be mentioned here.

The above uncertain symptoms prove nothing. They can exist in the male as well as in the female, in conditions other than that of the puerperal state.

2. Probable Signs.—These include signs existing in the genital tract and in the mammary glands.

Inspection of the vulva discloses a swollen condition, perhaps some œdema, the pigmentation of pregnancy, a gaping of the labia majora and minora, the ostium vaginæ is dilated, the inner aspects of the labia may show lacerations, the fragments of the torn hymen and fourchette, more or less injury to the perineum.

In primiparæ all of the above conditions may be easily recognized; in multiparæ, all or most of them may be absent.

The vagina may show lacerations, congestion, œdema, and increase in secretion. The rugæ are absent, and its calibre is so much increased that the whole hand can be introduced.

We pass on to the cervix and we find it fissured, with the external and internal orifices allowing the introduction of one or more fingers. The internal os remains patulous so that one or more fingers may be passed through it, up to the eighth or ninth day of the puerperium.

An enlarged uterus is present, which may be felt above the pubis for about ten days following parturition.

"Upon the internal surface . . . the placental site may be felt for the first seven or eight days" (Winckel).[1]

We find also the lochial discharge, which has its origin in the uterus, commences to flow immediately after the termination of labor, and continues with an average duration of

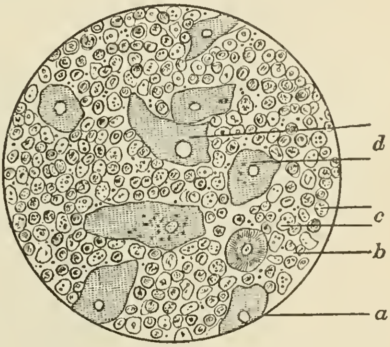


Fig. 52.—Lochial Discharge of the Second Day. A few isolated cocci and streptococci. Lochia cruenta. *d*, Epithelia; *c*, white blood-corpuscles; *b*, red blood-corpuscles; *a*, decidual cells. (Winckel.)

---

[1] *Loc. cit.*, p. 210.

from two to three weeks. The first two days this discharge is red (lochia rubra) and consists of fluid blood, blood clots, mucus, and pieces of decidua vera. About the third day it becomes sero-sanguineous, thinner in consistency (lochia serosa), and contains less blood and more mucus. Upon the seventh or eighth day it once more changes, is paler, thicker, more glairy in appearance (lochia alba).

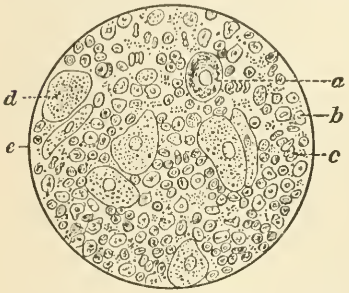


Fig. 53. — Lochial Discharge on the Fourth Day. *a*, Cells of the decidua; *b*, white blood-corpuscles; *c*, a few red blood-corpuscles; *d*, epithelial cells without nuclei from the vernix caseosa, with nuclei from the parturient canal; *e*, numerous clusters of cocci, partly in cells without nuclei, which are stained blue by Gram's method. × 330. (Winckel).

The mammary glands present the phenomena of pregnancy already referred to (see Diagnosis of Pregnancy). We notice the enlargement, the knotty feel, the pigmentation, striæ, swollen veins, areola, secondary areola, tubercles of Montgomery, and secretion. Colostrum (see Fig. 51, *a*) we obtain for the first seventy-two hours of the puerperium, and milk for the remainder (see Fig. 51, *b*).

These signs constitute what are termed the probable signs of a recent delivery. Standing alone, none of them offers positive proof; taken collectively, all or a major part justify us in making a positive diagnosis of the condition under consideration.

For example, the secretion of milk is a sign that pregnancy and labor have occurred, and yet it is a well-known fact that lacteal secretion may occur conditions independent of either gestation or parturition. It has even appeared in the male (see Diagnosis of Pregnancy).

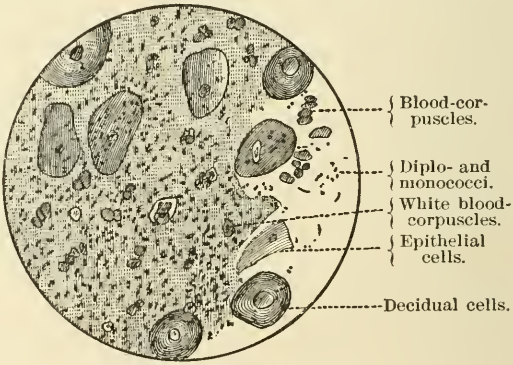


Fig. 54.—Lochia, Seventh Day. No elevation of temperature. (Winckel.)

The changes already described as occurring in the genital tract may all be simulated by various forms of inflammation, by lupus, malignant disease, and the passage of foreign bodies.

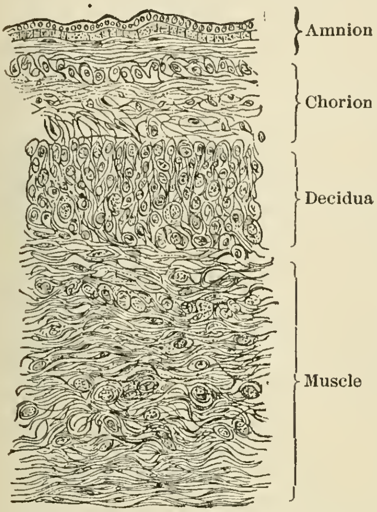


FIG. 55.—Membranes Adherent to the Uterine Wall. × 330. (Winckel.)

That there is a regularity or sequence about their onset, and that time causes certain well-understood changes in their appearance or condition, as the change from colostrum secretion to milk, the gradual diminution in size of the uterus, the changes in the lochial discharge, the rapid healing of lacerations, and so on—all these help us to form a positive diagnosis.

3. POSITIVE SIGNS.—"Positive proof of the occurrence of birth is only furnished by the discovery of parts of the ovum."[1]

If upon careful microscopic examination of the lochial discharges (see Figs. 52, 53, 54) we fail to find any evidences of remains of the ovum, we can with our finger or some appropriate instrument remove the remains of the placenta from the inner surface of the uterus, and can demonstrate the tissue found under the microscope, the diagnosis is fully established. "In most cases, the demonstration of shreds of the decidua with large nucleated and fatty cells, is of itself a sure proof" (Winckel). (See Figs. 55, 56, 57.)

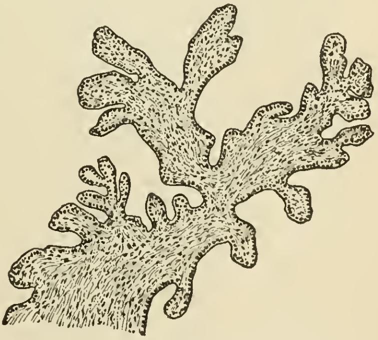


FIG. 56.—Villi of the Chorion (low power). (Winckel.)

---

[1] Winckel. The same author narrates the case of a servant who sued her mistress because the latter accused her of having had intercourse with her husband. He (Winckel) extracted "a small piece of tissue about the size of a pea from the external os, and easily demonstrated the presence of very pretty chorionic villi, thus proving at once the oc-

How Long After the Emptying of the Uterus can a Positive Diagnosis of Recent Delivery be Made?—By means of the signs enumerated, diagnosis of the puerperal condition will rarely be found difficult within ten or fourteen days after parturition.

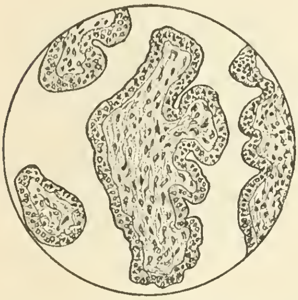


Fig. 57.—Villi of the Chorion. × 330. (Winckel.)

If the female has already borne children (multipara), the diagnosis cannot in some instances be positively established after the lapse of even a week or ten days.

If the case be one of a first labor (primipara), the character, intensity, and persistence of the signs present will permit a diagnosis to be made at a later date.

How Long a Period has Elapsed since Labor Terminated (Date of Delivery).—We are enabled to answer this question by carefully observing the character of the secretion from the breasts; the appearance and composition of the lochial discharge;[1] the height of the fundus uteri[2] in the abdominal or pelvic cavity; and particularly the *freshness* of the wounds that may exist in the genital tract.

b. **In the Dead.**—The diagnosis of recent delivery in the dead rarely presents any difficulty.

Many, if not all, the signs of recent delivery just enumerated as occurring in the living may be found in the dead, and in addition we are enabled to *see* the alterations that are present in the uterine body and its appendages.

The uterus immediately after labor weighs about twenty-four ounces; at the end of a week or ten days, about twelve

---

currence of cohabitation, conception, abortion, and destruction of the child."

[1] *Vide* pp. 343, 344.

[2] According to Dépaul, the height of the fundus of the uterus during the twelve days following labor at full term is as follows:

First day, one finger's breadth above the umbilicus.

Second day, on a level with the umbilicus.

Third day, a little below the umbilicus.

Fourth day, a little below the umbilicus.

Fifth and sixth days, two fingers' breadth below the umbilicus.

Seventh, eighth, and ninth days, three or four fingers' breadth above the pubic symphysis.

Tenth, eleventh, and twelfth days, at a level or a little below the pubic symphysis.

ounces; and by the end of five or six weeks has returned to its original size.

By about the ninth day after labor at term, if normal involution be present, the fundus of the uterus will be found behind the symphysis pubis.

The rate of return of the uterus to its normal size depends upon so many factors, as the period of gestation at which labor occurred, pathological conditions in the pelvis prior or subsequent to labor, the general condition of the woman, and so on, that any attempt to state positively from a post-mortem examination the exact date upon which parturition took place must be met with failure.

"The placental site, which is about the size of the palm of the hand immediately after birth, is about 3–4 cm. wide two weeks afterward and still somewhat uneven, due to projection of the thrombi from its surface. . . . Four to six weeks after labor the placental site may still be recognized, but is smooth and barely two-thirds of an inch, and the places formerly occupied by the vessels are now marked by yellow and black spots of pigmentation."[1]

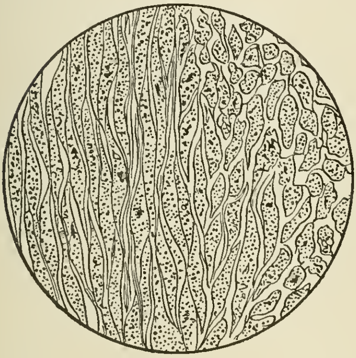


FIG. 58.—Muscle Fibres of the Puerperal Uterus. (Winckel.)

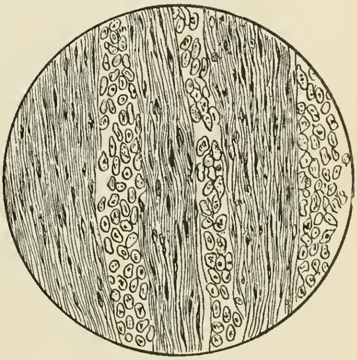


FIG. 59.—Muscle Fibres of the Gravid Uterus. (Winckel.)

The usual hyperæmia of pregnancy exists in the appendages of the uterus, but a few days suffice for this to disappear.

As to the signs of pregnancy revealed by a post-mortem examination: with the exception of those signs of pregnancy known as subjective signs, the remaining ones, known as objective ones, will in most cases be present. There are, however, two signs revealed by a post-mortem examination which have not yet been mentioned, viz.:

---

[1] Winckel, *loc. cit.*

(*a*) THE FINDING OF AN OVUM, EMBRYO, OR FŒTUS WITH ITS ENVELOPES WITHIN THE UTERUS.—The gross appearances of the ovum, embryo and fœtus, in the several months of gestation we have already considered on pages 291–294, and of course this constitutes a certain sign. What concerns us here is the second sign, and in the light of modern research we can no longer, as formerly, term it a sure sign of gestation, but only a probable one. It is:

(*b*) THE PRESENCE IN ONE OR BOTH OVARIES OF A CORPUS LUTEUM VERUM, OR OF CORPORA LUTEA VERA.—After the Graafian follicle or ovisac ruptures and discharges the ovum, certain changes take place in the ruptured follicle which result in the formation of the corpus luteum.

It has been claimed by authorities upon the subject that these changes differ according to whether pregnancy does or does not ensue. Hence it has been customary to speak of a false corpus luteum, a corpus luteum of menstruation (corpus luteum spurium), when gestation does not follow; and a true corpus luteum, corpus luteum of pregnancy (corpus luteum verum), when the ovulation is followed by pregnancy.

It is generally agreed by authorities upon the subject that the following phenomena usually occur:

(1) If the ovum discharged does not become impregnated, hemorrhage into the Graafian follicle, together with proliferation of the membrana granulosa, hypertrophy, convolution, and vascularity of the follicular wall, and staining of the mass thus formed with yellow pigment, results at the end of about twenty-one days in a body three-quarters of an inch in length by half an inch in depth. This is the corpus luteum of menstruation. Contraction and retraction now set in, and by the end of seven or eight weeks a simple scar upon the ovary marks the site of the corpus luteum.

(2) If impregnation ensues after the rupture of the Graafian follicle, "the corpus luteum, instead of reaching its maximum of development at the end of three weeks, and afterward undergoing a rapid process of atrophy, continues to develop itself for

a considerable period, and does not, in fact, become decidedly retrograde until after the termination of pregnancy."[1]

The corpus luteum of pregnancy does not commence to diminish in size until about the fourth month.

"During the fourth month, the corpus luteum diminishes by nearly a third, and toward the end of the fifth month it is ordinarily reduced one-half. It still forms, however, during the first days after parturition, and in the greatest number of cases, a tubercle which has a diameter of not less than from $\frac{2}{7}$ to $\frac{1}{3}$ of an inch. The tubercle afterward diminishes quite rapidly; but it is nearly a month before it is reduced to the condition of a little, hardened nucleus, which persists more or less as the last vestige of a process so slow in arriving at its final term. Nevertheless, there is nothing absolute in the retrograde process of this phenomenon. I have seen women, dead at the sixth and even the eighth month of pregnancy, present corpora lutea as voluminous as others at the fourth month.

"Although it may not be, in general, that after parturition the corpora lutea disappear, it is nevertheless not without example that they disappear much more promptly. I have had the opportunity of examining the body of a woman, dead in the course of the eighth month of pregnancy, in whom the absorption was already complete. Facts of this kind are doubtless very rare, as only one has occurred in my observations, notwithstanding the numerous researches to which I have devoted myself for a long time. . . .

"There exists a notable difference between the corpora lutea which are formed as a sequence of conception, and those which occur aside from the conditions developed by impregnation. The duration of the former is much longer than that of the latter, and the volume becomes also much more considerable, although their nature is, in truth, identical. I have too often had occasion to remark this, in the ovaries of suicides, to retain the slightest doubt in this regard" (Coste).

What is the medico-legal value of the corpora lutea? Does the presence in the ovary of the so-called true corpus luteum indicate positively that pregnancy does exist or has recently existed?

---

[1] Dalton: "Prize Essay on the Corpus Luteum of Menstruation and Pregnancy."

Modern investigation would seem to sustain the statement that no positive evidence is to be derived from either the false or the true corpora lutea. Instances are on record in which the so-called true corpus luteum has existed in the absence of pregnancy. (Cases 1, 2, 3, pp. 351, 352.)

Robinson[1] has studied the value of the corpus luteum verum and spurium, in the ovaries of women and animals, and comes to the conclusion that it is unjustifiable to elevate the corpus luteum to a medico-legal aspect in distinguishing pregnancy from non-pregnancy. He states that the yellow body may arise before rupture of the Graafian follicle and acquire its distinct convolution; and that the size of the follicle may be the same four months as sixteen months, or it may be a mere cicatrix two months after labor or even before. Hirst has shown that the so-called corpus luteum of pregnancy does not always indicate that impregnation has occurred.

He has pointed out that corpora lutea, identical with those of pregnancy, are found in the non-gravid female.

Again, pregnancy has existed where the so-called true corpus luteum has entirely disappeared before the completion of gestation. Coste describes a case where a woman died in the eighth month of pregnancy, and he found absorption of the corpus luteum complete. Finally, a ripe corpus luteum has been found in women neither pregnant nor menstruating.

Winckel says: "As regards the time that has elapsed since labor, the breasts, size of the uterus, the nature of its secretion and the *freshness* of the wounds present will aid in determining the point in question. In like manner the quantity and extent of the last-named conditions will determine the question as to whether the child was mature or born prematurely. On the other hand, it is not possible to establish the fact that twins have been born, in a woman who has been recently delivered. This question was put to me by one of our judges, and unless the placenta is still present, the possibility of such an occurrence must be admitted."

P. Dittrich[2] holds that a uterus not freshly puerperal will resist putrefaction longer than any other soft part of the body, and quotes cases.

---

[1] North American Practitioner, Chicago, Jan., 1891.

[2] Prager med. Wochenschrift, 1890, xv., 249–252. Wiener med. Blätter, 1890, xiii., 340–358, in a paper entitled: "Contribution to the Diagnosis of Deliveries having Taken Place."

CASE I.—A body of a young girl was found in a river and examined just one year after death. Of all the soft parts the uterus alone was preserved, and only showed the beginning grayish-red color of putrefaction, and its size, shape, and consistency proved its virginal character, the girl having been suspected of an abortion.

CASE II.—A young girl disappears; abortion and homicide are suspected; nine months later the body of the girl is found in a privy vault; the autopsy reveals the uterus alone preserved, and it is hard, a light red color, of virginal size quite recognizable, and its cavity quite normal, empty, and virginal, thus establishing the fact that she had not been killed because of pregnancy.

ILLUSTRATIVE CASES OF THE DIAGNOSIS OF DELIVERY.

1. *Hofe, J. W.: Virginia Med. Monthly, Richmond*, 1890–91, *xvii.*, 540–542.—Delivery of a normal placenta a year after abortion.
2. *Egan, P. B.: Med. Record, New York*, 1890, *xxxviii.*, 457. —Rupture of the membranes twenty-five days before the birth of a healthy child.
3. *Winchester, W. R.: Virginia Med. Monthly, Richmond*, 1890–91, *xvii.*, 26.—Bloodless labor.
4. *Meadows, A.: Trans. Obstet. Soc. London* (1875), 1886, *xvii.*, 355; 1876, 1877, *xviii.*, 69.—Note on the post-mortem diagnosis of a nulliparous uterus.
5. *Leonard, T. K.: Atlanta M. and S. Journal*, 1889–90, *N. S.*, *vi.*, 697.—An unusual case; labor with not a drop of blood lost either before or after the birth of the child. (The authenticity of this case depends upon the statements of a clergyman and his wife, who were certain not a drop of blood was lost during labor, not even after the expulsion of the placenta. The mother was very anæmic; the child, a boy, lived.)
6. *Heaton: Obstet. Gaz., Cincin.*, 1878–79, *i.*, 317.—Post-mortem indications of pregnancy.

ILLUSTRATIVE CASES OF THE CORPORA LUTEA.

1. *Benham, W. T.: Edinburgh Med. Jour., Aug.*, 1873 (quoted by Wharton and Stillé).—A young woman was confined for a number of years in a lunatic asylum. Death ensued, and a post-mortem examination presented signs of virginity, and a highly developed corpus luteum in one ovary. Impregnation was absolutely impossible in the case; and moreover the minute ovum of ovulation was actually detected within

the uterine cavity, thus proving beyond a doubt that the development of the corpus luteum did in no way depend upon the growth of the ovum.

2. *Popow, W. A.: London Lancet, May* 27th, 1882 (quoted by Tidy).—A prostitute 21 years old died from prussic-acid poisoning. At the post-mortem examination a fully ripe corpus luteum was found in the ovary, although at the time of death she was neither pregnant nor menstruating.

3. *Popow, W. A.: London Laucet, May* 27th, 1882 (quoted by Tidy).—A female, age 41 years, died from gangrene of a uterine fibromyoma. No pregnancy existed. One ovary contained a true corpus luteum which resembled that found in pregnancy.

III. SUPERFŒTATION.

By the term **superfœtation** is meant impregnation when an embryo already occupies the uterus, or the fertilization of a second ovum after the development of the first ovum has been going on in the uterus for a month or more. Two results may follow:

(1) Two children are born at the same time, but differing in development; or—

(2) Two children are born at different times, equally developed.

By the term **superfecundation** is meant the impregnation of one or more ovules after one has already been impregnated, or the fertilization of one or more ova of the same ovulation at a second coitus, after one has already been fecundated—"successive instead of simultaneous fecundation" (Parvin). The result of superfecundation is simply multiple pregnancy, but the children may or may not differ according as they possess the same or different fathers.

The term **superimpregnation** explains itself.

If all the above conditions are possible, we may have as the result of superfecundation—

1. The birth of twins or triplets with certain physical peculiarities proving that they have had different fathers.

And as the result of superfœtation—

2. The birth of children at the same time, differing in the degree of their development; or—

3. After the birth of a mature child, a second one, equally developed, may be born after a lapse of several weeks or months.

That superfecundation may occur in both woman and the lower animals is now a matter of certainty.

A mare is covered by a stallion, and after an interval of several days is covered by an ass; the result is twins—one a horse, the other a mule (Mende).

A setter bitch during the same ovulation (heat) is covered successively by a pointer and a mastiff; her puppies plainly indicate the different fathers.

Medical literature supplies abundant cases to illustrate superfecundation in woman.

For superfœtation to be possible, the occurrence of ovulation is required several weeks or months after the fertilization of the first ovum.

The physiological law in woman is for ovulation to cease as soon as impregnation takes place. Nature seemingly intended woman to be uniparous, although we see the exceptions in multiple pregnancy.

The believers in superfœtation lay stress upon the fact that because women apparently menstruate for one or more periods during pregnancy, therefore ovulation occurs at the same time.

Playfair cites the presence of menstruation as a proof of ovulation.

As has been already pointed out in this article, the presence of menstruation is no proof that ovulation is also present (see Duration of Pregnancy).

We have absolute proof that what is apparently menstruation does in certain rare instances continue for one, two, three, or even the nine months of gestation.[1]

We have at the present stage of our knowledge no absolute proof that ovulation accompanies these apparent menstrual epochs occurring during the period of pregnancy. Certainly we have no valid ground for denying that ovulation does thus in some instances occur.

Superfœtation proper, then, according to our definition, is possible—it is even probable. That it certainly occurs the present state of our knowledge does not permit us to state.

Cases of apparent superfœtation may be explained in other ways.

Twins are born together. One is apparently fully developed and the second one shows a decided lack of development, so that the second fœtus may be thought to be the result of superfœtation. A possible explanation is that the second twin failed to secure its proper supply of nourishment during intra-uterine life,[1] and slow development occurred.

---

[1] Any recent obstetric authority may be consulted.

In the case of triplets, two may die, and the third go on to complete development.[2]

In cases of twins where the less developed fœtus is dead at birth, we may look upon the phenomenon as simply that of a blighted ovum retained without decomposition.

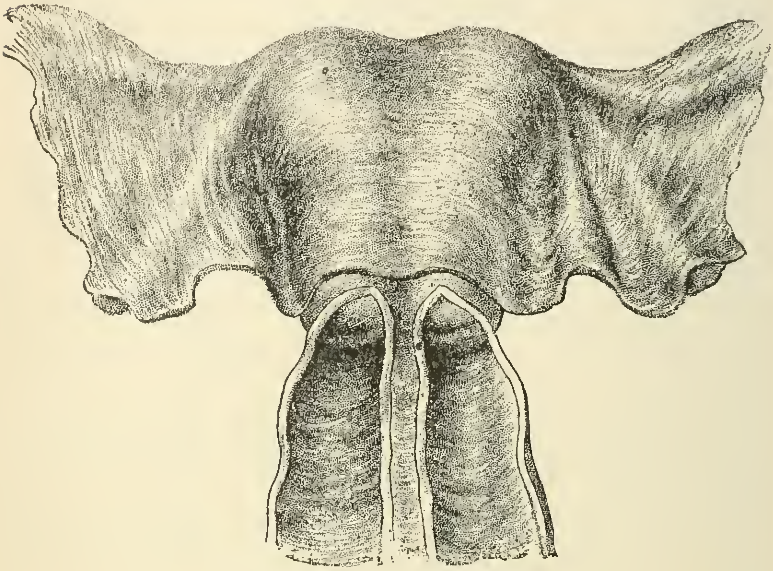


FIG. 60.—Double Uterus and Vagina.

Two well and equally developed children are born within an interval of several weeks or months of one another. These are the cases that are held out as examples of superfœtation. The phenomenon may be explained by the presence of a double uterus, or a uterus septus.[3] (Figs. 60, 61.)

---

[1] Winckel: "Text-Book of Midwifery," Phila., 1890, p. 119. Budin: Comptes rendus de la Soc. de Biol., 1883, Nov. 11. Galabin: "Manual of Midwifery," Phila., 1886, p. 227.

[2] Bock: Inaug. Dissert., Marburg, 1855.

[3] A case of this kind with double uterus may be found in a paper by Dr. Ross: Lancet, Aug., 1871.

The most difficult cases to explain on other grounds than those of superfœtation are those in which viable children have been born at an interval of *four months*. Such cases are on record,[1] and offer the strongest evidence in favor of the occurrence of superfœtation.

The best proof, however, that these cases are not due to superfœtation is that in five-sevenths of the number there is but a single placenta.[2]

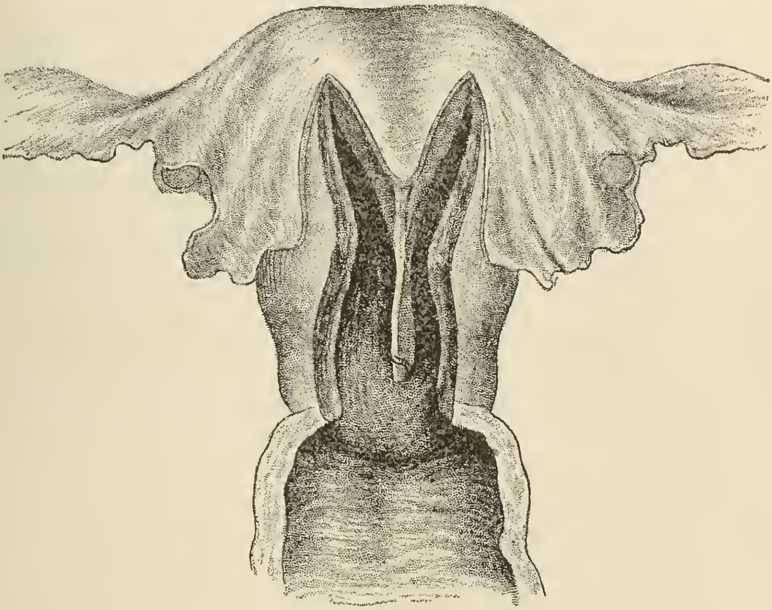


FIG. 61.—Uterine Cavity Divided by a Septum, the Neck of the Uterus and the Vagina Being Single.

The existence of pregnancy upon one side of a divided uterus teaches by experience that a decidua usually forms upon the other side.

There is nothing to prevent superfœtation occurring at almost any time of gestation, provided ovulation be present.

There are cases on record that were first thought to be those of superfœtation, but in which the presence of a double uterus was subsequently demonstrated.[1]

---

[1] "A Critical Inquiry regarding Superfœtation, with Cases." Dr. Bonnar: Edin. Med. Jour., Jan., 1865.

[2] Auvard: Archives de Tocol., April, 1883.

We are unable to state in how many of the cases of apparent superfœtation one or other of the above conditions existed.

Conclusions.

1. Superfœtation has in many instances been assumed without sufficient evidence.[2]

2. There are cases on record that we are unable to explain on any other ground than that of superfœtation.

3. Whether in all the cases of apparent superfœtation the uterus was normal is not definitely known.

"The result of all the observations made upon this subject is, that the majority of the alleged cases of superfœtation may be explained (1) upon the theory of twin pregnancies, where one fœtus has grown at the expense of the other, and is first expelled, the other remaining until it has acquired the proper maturity; (2) by the existence of a double uterus. Nevertheless, there are a few other cases which do not admit either of these explanations, and which cannot be accounted for except on the theory of two successive conceptions" (Reese).

ILLUSTRATIVE CASES OF SUPERFŒTATION.

1. *Way, E. W.: Australasian Med. Gaz., Sydney*, 1889–90, *ix.*, 166.—Notes on a case of superfœtation; uterine and extra-uterine.

2. *Althen: Centralbl. für Gynäk., Leipzig*, 1890, *xiv.*, 711–713.—Case of pregnancy in both compartments of a double uterus.

3. *Branch, F. S.: New Orleans Med. and Surg. Jour.*, 1890–91, *xviii.*, 189–191.

4. *Bonnar: Edinb. Med. Jour., Jan.*, 1865.—Cites cases to prove the occurrence of superfœtation, and "cases that prove, as far as anything of the sort can prove, that superfœtation is a positive fact."

IV. THE PERIOD THAT MUST ELAPSE AFTER DELIVERY BEFORE THE WOMAN CAN AGAIN BECOME PREGNANT.

How soon after delivery can a woman again be impregnated and become pregnant?

G. L. Bonnar, in his "Critical Inquiry regarding Superfœtation, with Cases,"[1] referred to elsewhere, reached some interesting conclusions in regard to this question. Not being satisfied with the then generally accepted opinion that a month must elapse between the termination of labor and a fresh conception, he undertook an investigation into what was known as "Hodge's Peerage and Baronetage." His results were as follows: In at least nineteen cases, the interval between one birth and another was less than 309 days. In ten cases the interval varied from 309 to 300 days, in two from 299 to 290, in four from 289 to 280, in one it was 273, in another 252, in another 182, another 173, and in one 127 days.

---

[1] See case of Dr. Ross.

[2] Galabin: *Loc. cit.*

Taking these cases in consideration, as well as the post-partum conditions of the uterus, lochia, and vagina, Dr. Bonnar placed the earliest date after confinement, when the woman could again become pregnant, as the fourteenth day.

Leopold's observations appear to prove that the repair of the uterine mucous membrane after confinement is not complete earlier than the end of the fourth week; that the red and yellow lochia cease the beginning of the second week, and that the white lochia continue until the sixth week.

Observations would tend to indicate that one-half of those women who do not nurse their children, and also those women who menstruate during the period of lactation, have their first post-partum menstrual period (and hence ovulation and capability of impregnation) within six weeks after confinement.

Concerning conception during the lying-in state, Krönig[2] described before the Gesellschaft für Geburtshülfe zu Leipzig the case of a IIpara, delivered in the Leipziger Frauenklinic, who had conceived on the fourth day following the delivery of her first child. She was twenty-two years old when delivered of a healthy child. Four days later she was subjected to coitus. Following this was three months' abstinence from intercourse. At four and a half months from the coitus the movements of the fœtus were observed, and on the 243d day labor occurred. The child, having every appearance of being at full term, measured 52 cm. and weighed 3,550 grams. After a careful study of the case, Krönig arrived at the following conclusions:

---

[1] Edinb. Med. Jour., Jan., 1865.

[2] Centralblatt für Gynäkologie, No. 19, 1893, and Univ. Med. Jour., August, 1893.

1. A fully developed child may be born after a period of pregnancy lasting 243 days.

2. The spermatozoön retains its vitality in the lochial secretion.

3. The ovarian activity does not entirely cease during pregnancy. The follicles ripen, and may rupture very soon after labor.

4. Menstruation and ovulation may occur independently.

5. In strong individuals there may be a rapid regeneration of the mucous membrane, rendering possible the attachment of an impregnated ovule in the earliest period of the puerperal state.

V. UNCONSCIOUS IMPREGNATION, PREGNANCY, AND DELIVERY.

1. Unconscious Impregnation.

Can a woman become pregnant in a state of unconsciousness? The answer is in the affirmative.

In cases of rape that are upon record, young girls have been impregnated while under the influence of some narcotic, or the anæsthetics such as ether and chloroform. That pregnancy may take place following intercourse under such conditions, all authorities upon the subject are agreed.

Artificial impregnation, where the seminal fluid has with suitable instruments been injected directly into the uterus, has also been successfully performed.

"That a woman should be unconscious both of the fact of sexual intercourse, and also continue unconscious of the resulting pregnancy up to the birth of her child, we decline to believe, unless she was feeble-minded or idiotic.

"Cases of this character frequently occur in unmarried females, who are wont to protest most earnestly their utter ignorance of the whole affair, and who pretend to ascribe the pangs of labor to colic or some other disorder; and who, when the child is shown them, will positively deny all knowledge of its origin" (Reese).

Upon unconscious conception and pregnancy T. Kost,[1] says: "Questions sometimes come up as to the possibility of a woman becoming pregnant unconsciously, and the judgment of a physician may be required on this point. Referring to this question then, as to the probable or possible facts, the answer is that such an occurrence is exceedingly improbable but is yet possible.

---

[1] "Text-book on Medical Jurisprudence for Medical and Law Colleges," Cincinnati, 1885, p. 189.

"Conception is not, in a physiological sense, a voluntary act; the conditions afforded are one thing, and the conception another, so the will or the consciousness, physiologically, is not a factor in the premises. Let the conditions once exist, then the physiological act is involuntary and takes place unconsciously. Some females have declared that they were conscious of the act of conception; but perhaps such averments are not in place. They can carry no further assurance than the moral question of veracity, since no descriptions of said sensations can afford a definition.

"The averment that it is easier or 'better felt than told' is not one that is of competency in a court, when it applies to a second party or concerns another person. The truth is, that conception itself is a physiological function independent of the will.

"Still the question returns, can the act necessarily antecedent to conception take place without the knowledge of the female? This may be answered in the affirmative. Instances are on record where females have been drugged, intoxicated, or otherwise made unconscious, and who have then been made victims of lusts.

"The question has also been put to physicians as to the possibility of a sleep being sufficiently sound to allow the unconscious occurrence of the act necessary for conception. Although, in the matter of sleep, like all other human affairs, there is hardly a limit to variety, we still could not say certainly what the possibilities are; but it may be safe to say, that in natural sleep such an event could not occur unconsciously. There may be congestion of the brain by overheating, over-excitement, or from certain diseases, so that it may become so oppressed as to produce catalepsy or a deep somnolency, that might admit of almost any ordinary force upon the body without mental consciousness thereof."

Can copulation and impregnation occur in a woman without her knowledge, during hypnotic sleep?

Brouardel,[1] who has studied and written upon this subject, states that under certain favorable conditions a woman can be ravished without her knowledge during hypnotic sleep.

---

[1] Gaz. des Hôpitaux, 1877.

If the suggestions offered to the somnambulist are acceptable or of an indifferent character, and not offensive, if the man himself is agreeable, then she submits herself to them; on the other hand, if the suggestions are revolting to her personal affections or her natural instincts, she opposes to them a resistance which is almost insuperable.[1]

"One may easily lead the hypnotized subject, for example, to sign a receipt for money, but if she has preserved her normal chaste instincts, anything opposed to those instincts will be sought in vain. But, on the contrary, if the sentiments and the acts offered by the magnetizer to his subject correspond with her own, she obeys readily his suggestions. In the great majority of cases, however, a woman does not recall in her waking state what happened to her in the state of somnambulism, or *vice versa;* yet the same feelings affect her in both states.[2]

Brouardel[3] experimented as follows:

"A young woman was hypnotized, first by pressure on a suggested hypnotic point and then by slight friction on the forehead.

"Brouardel then approached her and asked her if she would accept a loan of fifty francs. At first she refused; but on the suggestion being forced upon her, she gradually weakened and finally consented to accept the offer. A stamped receipt was then drawn up with every possible legal precaution, and the patient herself was quite anxious there should be no mistake about it. She then signed it and Brouardel put it in his pocket, but did not offer to give her the money. She was then awakened and acknowledged the receipt was signed by her, but could not remember under what circumstances she had been induced to sign it, or whether or not she had received the money. Legally the receipt was entirely valid, and the holder of it could collect payment for the loan."

ILLUSTRATIVE CASES OF UNCONSCIOUS IMPREGNATION.

1. *Sippel, A.: Centralbl. f. Gynaek., Leipzig*, 1881, *v.*, 202.—Conception without *immissio penis.*

2. *Med. Counsellor, Columbus*, 1855, *i.*, 423.—A case of impregnation without knowledge of the fact on the part of the female.

---

[1] F. W. Draper in Sajous' Annual, 1887.

[2] *Loc. cit.*

[3] *Loc. cit.*

3. *Braun, K.: Wien. med. Wochenschr.*, 1872, *xxii.*, 1121–1125. —On conception without perforation of the hymen and with positive impossibility of *immissio penis.*

4. *Börleben: Vierteljschr. f. gerichtl. u. öff. Med., Berlin*, 1885, *vii.*, 93–98.—Fecundation without *immissio membri.*

5. *Capuron: Méd. Lég. des Accouchements, p.* 86, mentions a case in which the fact of pregnancy was first ascertained at the end of the fourth month, by the woman having complained to one of her sisters of a strange sensation which she experienced in the lower part of her abdomen (quoted by Taylor).

2. Unconscious Pregnancy.

As is well known, it is not only possible but quite common for women to become pregnant, and remain so for some time before they become aware of their condition. This applies more particularly if not exclusively to the married females.

In the unmarried, in spite of their serious protestations of their entire ignorance of all concerning the matter in question, unconscious impregnation and pregnancy is a rare condition.

Many cases may be furnished, on the other hand, of married women, especially those childless for a number of years, who finally really do become pregnant, and then refuse to believe the medical attendant when assured that such is the case, believing their altered condition to be due to some disease.

"When a woman is impregnated in a lethargic state, it is unlikely that she should go beyond the sixth month without being fully aware of her pregnancy; and if her motives were innocent, she would undoubtedly make some communication to her friends."[1]

It must be borne in mind, however, that it is possible for a woman to carry her child to full-term, and be unconscious of the fact of pregnancy.[2]

"Instances of this kind are important in reference to alleged unconscious delivery in women charged with infanticide.

"At the same time, all cases in which there are motives for pleading unconscious intercourse or pregnancy require close examination; they will frequently be found to be quite unworthy of belief. This remark especially applies to unmarried women who often consult a medical man on their condition with full knowledge that they have exposed themselves to the chances of pregnancy. Up to the time at which the fœtal movements are perceptible a woman may honestly attribute her condition to other causes. Dating from the middle period of pregnancy, however, she must be aware of her state, but she endeavors to dissemble this even to herself" (Taylor).

---

[1] Taylor.

[2] See Tanner: London Obstet. Trans., vol. iv., p. 113, also London Lancet, 1861, i., pp. 609–643.

ILLUSTRATIVE CASES OF UNCONSCIOUS PREGNANCY.

1. Upon unconscious and concealed pregnancy, *Casper (Forensic Medicine, New Sydenham Society, London*, 1864, *vol. iii., p.* 378), says:

"Like every other medical man, I have in the course of my practice seen married women, who from large experience were very well acquainted with the signs and effects of pregnancy, and who had no desire to have such matrimonial blessings continually renewed, incredulous, for a hundred reasons, as to their state, up to the very last month of their new pregnancy, and prepared with a plausible explanation for each fresh symptom. In one case conception had occurred during suckling, which the woman incorrectly held to be impossible; at another time, the new pregnancy happened when it had long ceased to be dreaded, after a pause of many years—after so many as thirteen years in one of my own cases. The signs of pregnancy are obscured by the coexistence of disease; and then the intercourse in question is regarded as 'impossible' to have impregnated, and in this matter the most experienced matron is just as liable to error as the most inexperienced maid; while, at still other times, important irregularities in the catamenia have disturbed the reckoning, etc. Numerous cases of this nature are recorded in the literature of this subject. But in all such cases pregnancy *bonâ fide* existed, and it is credible that a young girl of sixteen should quite innocently carry about her distended abdomen, because, as she finally confessed, 'the Baron H., who had conducted her home from a ball, and had been with her only once, had solemnly assured her that the first time never had any result.'

(Gadermann, in Henke's *Zeitschrift*, 1846, 3, 5, 87.)

"But all ingenuousness ceases the instant the case becomes a judicial one, a case where different interests clash, and the forensic physician is engaged with it. For the most experienced, as well as the most inexperienced, will speak *mala fide* when in defence of her interests she declares that she knows not, or at least pretends not to know, that she even only once has exposed herself to causes of pregnancy. In the course of the precognitions in the criminal or civil case, ay, even from the mere consideration of judicial observation being continually directed to the condition of her body, the sum of the remarkable alterations in her corporeal state during the progress of pregnancy must become known to her in their true signification, and remembering the *ante acta*, the belief of the possibility of a pregnancy must more and more force upon her the conviction of its actual existence. The former Prussian statutes, therefore, were not unjustifiably harsh in denying that a woman after completion of the thirtieth week of her pregnancy could be any longer ignorant of her condition, and the forensic physician will in most cases not err, and will be able to answer on his conscience, when he assumes that at least during the last third of its continuance pregnancy is no longer unconscious—that is, that the concealment of it is not unintentional. The only possible exceptions to this may be where there is no recollection of any act of impregnation; that is, those rare instances of impregnation during a state of unconsciousness (p. 298, Vol. III.) or in feeble-minded or idiotic women. And as, in every matter, individual cases occur in medico-legal practice of such anomalous constitution as to constitute an exception to the general rule—so, also in relation to this subject, there may be a concurrence of circumstances in favor of the pregnant woman. Thus, in a case which, many years ago, was the occasion of *superarbitrium* by the 'Scientific Commission,' a young and very weak-minded girl was alleged to have concealed her pregnancy up to the time of delivery unintentionally because it was unknown. The reasons which induced the Superior Medical Board to regard her assertion as justified were as follows: the girl was constantly assured by her seducer 'that he had not come near enough to her to make her pregnant;' that as a primipara she had no experience in this matter; that it was proved that she had caught a violent cold while standing in a river washing; that she had blamed this cold for the cessation of her menses, which occurred shortly after, and for the enlargement of her body, etc.; and finally, that the surgeon to whom she had applied on account of this completely confirmed her opinion, and continued to give her remedies to bring back her catamenia. I think, therefore, that the forensic physician will have no difficulty in any case in deciding this question, which is of by no means so frequent occurrence as formerly."

2. *Rüttel: Henke, Zeitschrift der S. A.*, 1844, *p.* 264, mentions the case of a woman, age 41, who had been married upward of sixteen years, and who, while returning from a neighboring village, was suddenly delivered of her first child, when only a few days before she had been complaining that she was not likely to have any children. The child was mature and lived. (Quoted by Taylor.)

3. *Long: Med. Times and Gaz.*, 1857, *i.*, *p.* 592, reports a case in which a married woman, age 24, subject to irregular menstruation, consulted him for an attack of spasms. On his arrival he found that she had suddenly given birth to a seven-months' child. Neither her husband nor herself had the slightest idea that she was pregnant. She had

noticed that she had become somewhat stout, and that her breasts were more full than natural. She had attributed her condition to improved health, and the cessation of the menstrual discharge was set down to some accidental cause. (Quoted by Taylor.)

4. *Lond. Med. Gaz., vol. xxxix., p.* 212.—A young woman who had intercourse knowingly was supposed not to have been aware of her pregnancy until the seventh month; but there is reason to believe that this woman was guilty of deception. (Quoted by Taylor.)

5. *London Lancet,* 1860, *i., pp.* 609–643.—Cases of unconscious pregnancy in married women.

6. *Tanner: London Obstet. Trans., vol. iv., p.* 113.—A married woman who had not had a child for a period of nineteen years, found herself, as she thought, getting unusually stout. She was moving about with her family from place to place. At last her size alarmed her, and she thought she was suffering from dropsy. She consulted a physician who informed her that she was in an advanced stage of pregnancy. She treated his opinion with great contempt. In travelling with her daughter she arrived at a miserable inn, and on the night of her arrival this lady was seized with labor pains, and was delivered of a child. No preparations had been made for the birth, and up to the onset of pains she had not, with all her former experience, the slightest idea that she was pregnant. (Quoted by Taylor.)

3. Unconscious Delivery.

Is it possible for a woman to be delivered in a state of unconsciousness?

We find Tidy making the following answer to this question:

"Both published cases and the author's experience oblige an answer in the affirmative. These cases are, however, very rare, and the woman could scarcely be long ignorant that something unusual had happened, unless she were the subject of puerperal mania, or of some other form of insanity."

The possibility of unconscious delivery is especially important in regard to the subject of infanticide; the plea being that the woman was unconscious of the act of parturition.

That women may be unconsciously delivered while under the influence of narcotic poisons—*e.g.*, the vapors of chloroform, ether, or intoxicating liquors, while suffering from some form of coma, asphyxia, syncope, or in the act of dying, there is no doubt.

Cases are appended where women have been delivered unconsciously during profound sleep.

An attack of hysteria is another condition in which a woman may be confined without her being conscious of the fact.

In the two latter conditions, however, unless profound and deep, it is more than likely that the pains of the expulsive stage of labor would arouse the woman.

This is especially true of primiparæ, namely, those bearing their first child. Every obstetrician, however, is aware that in some women, particularly old multiparæ with roomy pelves and relaxed soft parts, a very few and almost painless contractions of the uterus are sufficient to rapidly and easily empty the womb.

Perhaps the most frequent diseased condition in which a woman may be unconsciously delivered is the stupor, convulsions, or coma of puerperal eclampsia. As is well known, puerperal mania often follows this condition.

Under the preceding conditions it is quite possible for a woman to be confined, injure or even kill her child, subsequently to be restored to consciousness, and be perfectly truthful in her assertion of her entire ignorance of what had happened.

Of course the clinical picture of puerperal albuminuria or eclampsia would sustain her statements.

Among the illustrative cases appended will be found those where the expulsion of the child was mistaken for a strong desire on the part of the woman to empty her bowels.

This is a common defence set up for the charge of child-murder.

An intense desire to empty the lower bowel accompanies the expulsive stage of labor, and from our present knowledge of the subject gleaned from many cases reported by competent observers, a woman may be seized with this intense desire to defecate, hurriedly enter a water-closet or privy, and be absolutely ignorant of the act of parturition, until too late to save the expelled child from injury.

Such accidents are possible and have happened. Before such an occurrence is accepted in a given case, a thorough investigation should be made by the medical witness, including a vaginal examination of the woman in question.

In addition we must bear in mind that while the woman may in a given case be unconscious of the expulsion of her child at the moment of delivery, yet she cannot remain ignorant of the fact that she has been delivered, if she be at the time conscious.

ILLUSTRATIVE CASES OF UNCONSCIOUS DELIVERY.

1. *Weill: Gaz. Méd. de Strassburg*, 1881, 3, 1, *x.*, 103.—Observations of a woman who was delivered during sleep.

2. *Spiegelthal: Mag. f. d. ges. Heilk., Berlin*, 1825, *xx.*, 183.—Delivery without the consciousness of the parturient woman.

3. *Smith, G.; Edinburgh Med. Journal*, 1862, 3, *viii.*, 477.—Case of unconscious delivery.

4. *Shortt, J.; Trans. Obstet. Soc., London*, 1863, *iv.*, 210.—Case of unconscious and sudden delivery.

5. *Case, M. W., Amer. Journ. Med. Sciences, Phila.*, 1886, *lv.*, 279.—Labor during sleep.

6. *Amiss, N. Y. Med. Press*, 1859 N. S. II., 773.—Unconscious delivery.

7. *Albert: Ztschr. f. d. Staatsarznk., Erlangen*, 1830, 13, *Ergnzngshft.*, 284–301.—Labor without pain.

8. *Fox, D. D.: Trans. Louisiana Med. Soc., New Orleans*, 1888, 209–211.—A woman who has had eight children completes her full term of utero-gestation without being aware that she is pregnant.

9. *Berthier: Ann. Soc. de Méd. de Lyon*, 1859, *vii.*, 66–69.—Melancholia and delirium produced by a pregnancy unsuspected by all, including the patient. The pregnancy terminated in a labor without the knowledge of the patient.

10. *Genth N.: Ztschr. f. Geburtsk., Berlin*, 1848, *xxiv.*, 77.—Unconscious delivery in the case of a healthy woman.

11. *King, H. G.: Med. Times, London*, 1847, *xvi.*, 234.—Birth of a child without the knowledge of the mother.

12. *Palfrey, J.: Lancet, London*, 1864, *i.*, 36.—Twin labor in which uterine action commenced and progressed to the second stage during sleep.

13. *Samelson, A.: Brit. Med. Journ., London*, 1865, *ii.*, 550.—Delivery during sleep.

14. *Verrier: Journ. de Méd. de Paris*, 1890, *ii.*, 309–312.—De l'hypnotisme pendant le travail de l'accouchement.

15. *Blanckmeister: Monatssch. f. Geburtskund. u. Frauenkr., Berl.*, 1854, *iii.*, 13–15.—Case of painless labor.

16. *Cripps, F.: Lancet, London*, 1841–42, *ii.*, 367.—Absence of pain in parturition.

17. *Colton, R., Jr.: Med. Bull., Phila.*, 1879, *i.*, 68.—A painless labor.

18. *Davis, J. W.: Nashville Journ. Med. and Surg.*, 1881, *xxvii.*, 252.—Several cases in midwifery illustrating the absence of pain in labor.

19. *Depaul: Journ. des Sages-Femmes, Paris*, 1882, *x.*, 9.—Femme

tombée sur la voie publique et ayant accouché pendant une syncope qui a durée quatre heures ; enfant vivant.

20. *Murray: Med. and Surg. Sep., Phila.*, 1877, *xxxvii.*, 69.—Painless labor.

21. *Clay, C.: Lancet, London*, 1841–42, *ii.*, 404–407.—On the prevalence of almost unconscious parturition in manufacturing districts, with remarks on unconscious conception and parturition.

22. *Badger, W.: Med. Rec., N. Y.*, 1879, *xvi.*, 600.—Painless labor.

23. *Anderson, R. B.: South. Med. Rec., Atlanta*, 1879, *ix.*, 86.—Childbirth without pain.

24. *Fanton: Marseilles Méd.*, 1889, *xxvi.*, 660–665.—Arch. de Tocol., Paris, 1890, xvii., 104–108.

25. *Hite, C. E.: Cincin. Med. News*, 1873, *ii.*, 260.—Case of painless labor.

26. *Gillette: Amer. Journ. Obst., N. Y.*, 1879, *xii.*, 329.—Painless labor. In this case the woman had been for some time an inmate of an insane asylum. Pregnancy occurs, her mental condition being good. When full term approached, a physician was called, and he found her seemingly very comfortable, seated in an arm-chair.

The woman stated she had no pain whatever, and that labor had not begun. Some spasmodic shaking of the hand at regular intervals led Dr. Gillette to suspect uterine contractions ; an examination showed a fully dilated os, and the head low down in the pelvis. The regular spasmodic shaking of the hand continued and corresponded with the uterine contractions. Forceps were used, and recovery was good.

27. *Laugier, Maurice: Annals d'Hygiène, v.*, 25, 1891, 380. Also : *La Semaine Médicale, Paris, Dec.* 10, 1890.—A woman, eight months pregnant, accompanies her child, suffering from pertussis, to the hospital. On the journey she suffers from colic, and having been constipated for five days she takes a rectal injection which causes her to feel the need of immediate defecation.

She sits on the vessel, with the right arm bent holding on to the bed for support. Child immediately expelled into the vessel with a quantity of blood-tinged liquor amnii and fecal matter. The unbroken cord was cut and tied. Child lived. Woman did not even cry out at moment of expulsion. Fifteen minutes before delivery no symptoms were present. Colic began at that time. Three years before same woman had been delivered rapidly without pain.

The writer suggests that if she had had her accident under other circumstances, if the child in falling from her had broken the navel cord and had passed into a vault below, the question whether or not there had been an intentional infanticide would have been an exceedingly difficult one to answer.

28. *Brunon: La Normandie Médicale, Rouen, Aug.* 15, 1891 ; *N. Y. Med. Journ., Sept.* 6, 1890.—Brunon recently reported to the Société

de Médecine of Rouen the case of a primipara whose labor was so nearly painless that she herself mistook it for difficult defecation and would have been delivered in the water-closet if she had not been removed from it. She only felt lumbar pains and a sense of weight in the rectum, and was not aware of the flow of liquor amnii. Brunon infers from this case that the discovery of a new-born infant in a water-closet pan does not necessarily raise the presumption of premeditated infanticide.

29. *Tarnier: Journal des Sages-Femmes, Juillet* 10, 1891; *Nashville Med. and Surg. Journ.*, 1891, *p.* 286, *No.* 8.

Case I.—A woman in Tarnier's ward had a shoulder presentation; this he corrected externally, although the membranes had ruptured some time before. A few hours afterward the cries of a child were heard, and the patient and midwife both were surprised to observe that the child was born.

Case II.—Tarnier narrates that he once delivered a woman who never stopped laughing and talking through the performance, and she declared that the uterine contractions caused her no pain.

Case III.—Another case narrated is that of a child being found between the thighs of a sleeping woman, the birth having taken place during sleep.

Case IV.—A woman, who had once experienced a precipitate labor, came to his wards, and upon retiring to the closet to defecate the child was born, the woman thinking meanwhile that a movement only of the bowels had taken place. Tarnier concludes from this and similar cases that unconscious delivery into the pan of a water-closet is possible. In these cases the cord is broken off; if there be infanticidal intent the cord is *cut*.

Case V.—Another woman, about to be delivered by Tarnier, suddenly gave birth to a child without any pain being caused, the sensation being that of something simply slipping away.

30. *Fanton, Archiv de Tocologie, No.* 2, 1890, reports twelve cases of labor in which labor occurred while the patient was in hypnotic sleep. In none of these cases were the parturients aware that labor had taken place, nor was there any complaint that pain was felt. Unless the attempt at hypnotizing was made at the very beginning of labor, before strong uterine contractions set in, in some cases it was impossible to hypnotize the women. One patient upon waking after labor said that the sensation resembled that of intoxication.

POST-MORTEM PARTURITION.

(COFFIN-BIRTH.)

THE title chosen is that used by Aveling,[1] the only author in the English language who has made anything approaching an exhaustive study of the subject. His paper, published in 1872, in the "Transactions of the Obstetrical Society of London" (Vol. XIV., p. 240), has furnished the basis for every contribution to the literature since that date, and it must be said that, except so far as the multiplication of cases, which, here as everywhere, goes hand in hand with the increase in medical writings, throws light upon it, no contribution had added anything of importance toward the elucidation of this peculiar phase of the question of pregnancy.

Post-mortem parturition acquires its medico-legal significance from the possibility of physicians and midwives, the latter particularly, being made defendants in suits for malpractice on the ground of the delivery of the child after death of the mother, and on the contention that this accident was preventable and due to lack of skill or ignorance on the part of the practitioner. The case given at length by Moritz[2] is the best illustration at command of this charge.

A midwife was called in at twelve midnight to see a woman, æt. 35, who was in labor, having been perfectly free from pain during the previous twenty-four hours. She was sitting in her husband's lap, but was put to bed and the midwife performed repeated manipulations upon her. She afterward declared that she could feel the head, but could not deliver the child. The woman died at seven A.M., still undelivered. She was buried three days later, June 23d. In consequence of the denunciation on July 5th, the midwife being accused of malpractice and death of the patient through negligence, the body was exhumed on July 28th, thirty-eight days after death.

The autopsy was made by the author of the report. The abdomen was found distended by gases of putrefaction and between the thighs lay the body of a male child, 49 cm. in length and fully matured. Its back lay uppermost with the head near the mother's knees, bent slightly forward and to the left. The feet lay near the mother's vulva. The infant was attached by a cord, 47 cm. long, to a placenta which was adherent to the uterine wall at one point only. This organ (the uterus) was completely extruded and lay between the thighs inflated to the size of a man's head by the putrefactive gases contained in it. It was inverted, of course, and with it the vagina, so that the vaginal mucous membrane lay in contact with the labia minora. The labia majora were swollen and everted. On opening the abdominal cavity, a quantity of foul-smelling gas escaped. The uterus did not lie in its usual position, but at the point corresponding to the internal os, the peritoneum was forced by the pressure of the gas toward the outer genitals and showed a slight puckered rent, through which the gas contained in the uterus could be forced into the peritoneal cavity. The womb at the same time was collapsed and could be returned to its normal situation. Decomposition was far advanced, and the examiner found it impossible to state the cause of death from the results of the post-mortem alone. He neglects to throw any light upon the outcome of the trial; in fact, he makes no mention of its having been brought into court, an omission which is unfortunately noted in all these cases.

---

[1] "On Post-Mortem Parturition," etc.

[2] Vierteljahresschrift f. gericht. Med., p. 93, Bd. v., 1893 (see also Table, case No. 66, Bleisch).

Literature.—A search through works on legal medicine in French, English, German, or Italian fails to reveal a single treatise on this subject. When it receives even a passing notice, the question is dismissed without discussion (Casper-Liman, Forsyth, Ryan, Reese, Tidy, Taylor, Paris and Foublanque, Male-Smith, Puy, etc.). The cases are scattered through literature of medicine from the middle of the sixteenth century (1551) literally to the present day. The first reports were monographs in Latin (cases 1, 2, 3, etc., see table); four are taken from the *Ephemerides* (cases 7, 12, 13, and 18), and two are found in Harvey's "Anatomical Exertions" (cases 4 and 24). The collection of the older papers is the work of Aveling and is more curious than of any scientific value. The mind of the mediæval writer seemed to find it impossible to shake off the fetters of superstition and to escape the allurements of the marvellous toward a perversion of the truth. It has seemed best, since these cases number less than seventy, to tabulate them for comparative study, after the fashion of Reiman,[1] appending to his collection of 64 cases those of more recent date. His material in turn was gathered from various sources, among others from

---

[1] "Ueber Geburten nach dem Tode der Mutter." Archiv für Gynäkologie, Bd. xi., Hft. 2, p. 215, 1877.

Deneux,[1] from Maizier,[2] from Meli,[3] from Toralli,[4] von Mende,[5] Casper and Aveling. Short notices of spontaneous birth after death will be found as well in Spiegelberg ("Lehrbuch der Geburtshülfe," 1878, p. 595) and Schroeder ("Lehrbuch der Geburtshülfe," 1888, p. 486).

In spite of the relatively large number of cases of post-mortem parturition and the fact that its occurrence has been recognized for three and a half centuries, it would appear that the knowledge of the subject was until recently, perhaps, by no means widely disseminated, which is due partly, no doubt, to the little notice which medical jurists have taken of it. The members of the London Obstetrical Society (1870) and of the Paris Society of Hygienists and Medical Jurists (1873) expressed, without hesitation, their doubts as to the possibility of such an event (cited by Reiman, *Archiv f. Gynäk.*, Bd. XI., p. 216, Hft. 2, 1877).

Since the appearance of the paper just quoted and that of Aveling, however, this position has been abandoned and discussion has been transferred to other points (*vide infra*). Some of the reports, abstracted in the following table, are necessarily incomplete, but we have thought it best not to omit any, in order to make the treatment of the subject as broad as possible.

In the case reported by Bleisch (No. 66) the midwife who attended the case, and who had been forbidden by the authorities to practise her vocation, was made party in a suit for malpractice. The report is shortly as follows:

> The woman died undelivered suddenly after several hours of labor in the second stage, attended by the midwife. The fact of her death and undelivered condition was verified by a physician, two hours later. Five hours afterward, the body was placed in the coffin and no signs of approaching birth were noted by several lookers-on. On the third day, when the coffin was reopened, the corpse lay in the usual position and in front of the prolapsed, extruded uterus was found the body of a child.

In this case the question was raised as to whether the prolapse of the womb was ante or post mortem, such an accident

---

[1] "Mémoire sur la Cause de l'Accouchement spontané après la Mort," 1823.

[2] "De Partu post Matris Mortem Spontaneo," Berlin, 1835.

[3] "Della Proprieta Vitale dell' Utero Gravido," etc., Milan, 1822.

[4] Dissertatio Inauguralis.

[5] "Beobachtungen und Bemerkungen aus der geburtshülflichen und gericht. Med.," Bd. i., Göttingen, 1825.

Case No.	Author and Reference.	Year.	Cause of Death.	Duration of Pregnancy.	Birth of Child—Length of time after Mother's Death.	Condition and Position of Child.	Condition of Mother's Body, after Birth.	Unusual Conditions present at Birth.
1.	Rudolph Cammerarius. Silloge memorabilium med.	1551	Hanging by order of Inquisition.	Far advanced.	Four hours.	Two living children.	Birth occurred while mother's body was still swinging from gallows.	
2.	G. A. Reiss. Elysius corpus jucund. quæstion.	Unknown	Illness.	Last month.	One day.	A living child—head only born.	Not stated.	....
3.	Diomedes Cornarius Nymmanus. De vita fœtus.	Unknown	Labor; after 3 days' duration of pains.	Unknown.	Found in coffin after one month.	Unknown.	Unknown.	....
4.	Harvey. Anatomical Exertions.	1653	Unknown.	....	Found on morning after death.	Dead child between mother's thighs.	....	....
5.	Rolfinkius. Dissert. Anatom.	Unknown	Eclampsia.	....	On fifth day in coffin.	Two dead children.	....	....
6.	Bartholinus. Acta med. et philosoph. Hafn. vol. ii, obs. 35.	1673	Manipulations by three midwives during parturition.	....	Forty-eight hours.	Dead child between thighs of mother.	Body much distended (by gas?)	Birth attended by loud noise.
7.	Ressler. *Ephemerides natur. curios.* Dec. i. Ann. 3.	Unknown	Sickness.	Last month.	On third day.	One dead child (with two teeth).	Dark mottling of putrefaction.	....
8.	Ressler. Shurig, "Embryologie," p. 127.	Unknown	Eclampsia.	Beginning of labor.	On second day.	Dead child.	....	Birth occurred at washing of corpse
9.	Phillip Salmuth. Shurig, "Embryologie," p. 127.	Unknown	Unknown.	Beginning of labor.	On third day.	Dead child.	....	....
10.	Same author and reference.	Unknown	Unknown.	Beginning of labor.	"Short time."	Not stated.	....	Noise accompanied birth.
11.	*Idem*..................	Unknown	Found dead.	Beginning of labor.	On third day.	Not stated.	....	....
12.	*Ephemerides*, Dec. ii, Ann ii. Shurig, *loc. cit.*	Unknown	Acute illness.	Last month.	On second day.	Dead child lying in coffin by mother's feet.	....	....
13.	Georgius Dethardingius. *Ephemer.* Ann. vii and viii.	Unknown	....	Beginning of labor.	One-half hour.	....	....	....
14.	Valerius Maximus. lib. i, Caput ultm.	....	Labor.	Beginning of labor.	"Some time" after death.	A living child.	....	Accompanied by noise.
15.	Hagendorn. Hist. med. physic., cent. iii, hist. 3.	1683	....	Labor begun.	One hour.	Living child.	....	Accompanied by noise.

16.	Johannes Matheus. Shurig, "Embry.," p. 127.	....	....	Labor begun.	One hour.	Living child.	....	Noise.
17.	Phillip Salmuth. Obs. med cent. iii. Obs. i. Shurig, "Syllepsologie," p. 199.	....	Violent death.	Labor not begun.	"Short time."	Twin children dead.	....	....
18.	J. C. Menzel. *Ephem.* Memor. nat. curios. Dec. iii, ann. ii, Obs. 121.	....	Labor,	Labor begun.	Following day.	Two dead children. One found by mother's side, the other projecting through a rent in the abdominal wall caused by putrefaction and pressure of gases. Uterus ruptured.		
19.	Wolff. Observat. chirurg. Lib. i, Obs. 41.	1667	Labor.	....	Eighteen hours.	A dead child lying between thighs.	Body lay on its side in coffin.	....
20.	Bonetus. Medicin. Lentenz, p. ii, Obs. 30.	1633	Eclampsia.	Labor begun.	On third day.	Child dead, but still warm (?) attached to cord.	Placenta not freed from uterine attachment.	....
21.	Henricus Stapedius. Shurig, "Embryologie," p. 121.	....	Illness.	Not stated.	On day following.	Dead child between thighs.	....	....
22.	Schenkius. Obs. med., lib. ix. De Partu.	....	Labor.	Labor begun.	Ten hours.	Dead child.	....	Accompanied by noise.
23.	Vestingius. Obs. Anat. 7.	1630	Epilepsy (?)	....	On eighth day.	Dead child.	....	....
24.	Harvey..............	....	....	....	Twelve hours.	Dead child between legs.	....	....
25.	Willugnby. "Country Midwives." Opusculum.	1650	....	Five days in labor pains.	From five to six hours.	Dead child and placenta between legs.	....	....
26.	*Gentleman's Magazine*, vol. 29, p. 390.	1759	Sudden death.	Labor begun.	Twenty-four hours.	Placenta free. Living(?) child which died.	Uterus inverted.	....
27.	Toralli. Dissert Inaugur.	1794	....	Fifth month.	Twenty-four hours.	....	Placenta free. Uterus inverted.	....
28.	Börner. *Journ. für chirurgia*, u.s.w.,i, p. 519.	1793	Unknown, perhaps perforation of ulcer of stomach.	Last month.	Twelve hours.	One dead child—placenta lying in os free.	Inversion of uterus.	....

NINETEENTH CENTURY.

29.	Stark. *Archiv*	....	Only mentioned without details.					
30.	Jütterland. Schmid's Jahrbücher, 1835, Bd. ii.	....	....	Labor not begun.	On following day.	Dead child between the thighs.	....	....

Case No.	Author and Reference.	Year.	Cause of Death.	Duration of Pregnancy.	Birth of Child—Length of time after Mother's Death.	Condition and Position of Child.	Condition of Mother's Body after Birth.	Unusual Conditions present at Birth.
31.	Clarke. London Med. Repository.	1817	Sudden death.	Eighth month.	Forty-eight hours.	Dead child by mother's side.	No changes observed in corpse twenty-four hours after death. Putrefaction after thirty-five hours.	
32.	*Journ. Univer. des Sciences Méd.*, tome ii.	......	......	......	Twelve hours.	Dead child.	......	......
33.	Klose. Casper's System, vol. xi, 2, 1856.	1856	Fever.	......	On third day.	Dead child outside vulva, attached to cord.	......	......
34.	Hochstetter. *Zeitschrift für Staatsarzneik.*, xii, 1826.	......	......	......	After twenty-seven hours.	......	......	Accompanied by noise.
35.	Muhrbeck, mentioned by Mende.	1844	Labor.	......	......	Dead child between mother's thighs.	......	......
36.	Baudelocque. Denneux "Mémoires."	......	Labor.	Labor begun.	Five hours.	......	......	Birth sudden accompanied by noise.
37.	*Annales d'Hyg. Publiques*, 1873, ii, p. 224.	......	Drowning, body in water 8-10 days.	......	One day after being taken from water.	......	......	......
38.	H. von Berne. *Med. chir. Zeit. v. Salzburg.* 1824.	......	Typhus.	Sixth month.	On evening before burial.	Two fœtuses.	Advanced in putrefaction.	Noise.
39.	Naumann, no reference given.	1802	......	Labor begun.	Thirty-six hours.	One child—placenta adherent.	Beginning putrefaction.	......
40.	Wolff. *Magaz. f. Gesamm. Heilk.*, xiii, 1826.	......	Typhus.	Fortieth week (Xpara).	On second day.	One child between thighs.	Body putrefied. Uterus inverted.	......
41.	Elias von Siebold. *Journ. für Geburtshülfe*, vol. x, 2.	......	......	End of pregnancy.	Forty hours.	One child lying with placenta between thighs.	Body putrefied.	......
42.	Hoyer. Fodéré—Traité de Méd. Lég., i, ii.	......	Labor.	......	While being carried to grave.	......	......	Accompanied by noise.
43.	Bell's Weekly Messenger, 1812, Sep. 26.	......	Eclampsia.	Last month (primipara).	On fourth day.	One dead child.	......	......
44.	F. J. Dillon Lanigan. *Med. Press and Circ.*, April, 1872.	1862	Labor.	......	On third day.	......	......	......

45.	Bedford, Sydney, N.S. W. Grey's Hosp. Reports, vol. x, 1864.	1864	Labor.	(VIIpara).	On seventh day.	Dead male child. Head towards mother's feet.	Inversion and prolapse of uterus. It was extruded with adherent placenta.	....
46.	C.H.Roach. *Med. Press and Circ.* April, 1872.	1869	Labor, after 48 hours of pains.	(Primipara).	After thirty hours.	Placenta and child born together.	....	....
47.	A. C. Swayne, *Med. Press and Circ.*, April, 1872.	1872	Labor, after 24 hours.	(VIIIpara).	Child not born when laid in coffin. Found on exhuming on fourth day.	Dead child, feet toward mother's genitals. Attached to loose placenta.	Uterus prolapsed. Rent through its body.	Noise.
48.	Snow Beck. *London Obs. Trans.*	1858	Death in convulsions, after 3 days of labor.	....	Next day.	Only head born.	Body putrefied. Rent in uterus through which the child was forced.	
49.	Seibert. *Ann. d'Hyg. Pub.*, M. 39, 1879.	1873	Sickness, character unknown.	....	On third day.	One child without cord.	Prolapse and inversion of uterus.	....
50.	Official Rep. of County Physician, Skwira, Kiew, Russia.	1874	Sickness of 24 hours' duration.	....	Next day.	Examination on fourth week after death and only skeleton of child remaining.		Body decomposed
51.	Darby. *Dublin Journ. of Med. Sci.*, 1875, ii.	1871	Typhus.	Beginning of labor (IIpara).	Seven hours.	Dead child.	....	....
52.	Casper. *Vierteljahrsschrift f. gericht. Med.*, Bd. x, Hft. 2, 1856.	1853	Death by strangulation. Murder (?)	Seventh month.	Unknown, found in medical examination.	Skeleton of child outside genitals.	Body decomposed.	....
53.	Schillinger. *Viertel. f. ger. Med.*, Bd. xi, 1, 1857.	....	Eclampsia.	....	On third day.	Dead child attached to a free placenta.	....	....
54.	Lebedew, Grodno, Russia.	1868	Burns.	(Primipara).	On third day, no signs during preparation for burial.	....	....	Accompanied by noise.
55.	Loescher, *Viertel. f. g. Med.*, xix, 1858.	1851	Labor after 24 hours.	Labor begun, waters discharged (Multipara).	Twenty-four hours.	Only head born.	....	Accompanied by noise.
56.	Frentrop. *Vier. f. ger. Med.*, xiv, 2, 1858.	....	Labor.	Labor begun, waters discharged 48 hours before death.	Twelve hours.	Child lay between mother's thighs. Placenta not expelled.	....	....
57.	Richter. *Viertel. f. g. M.*, xix, 1, 1861.	1861	Eclampsia.	First stage of labor.	Sixty hours.	Child and placenta found between thighs.	....	....
58.	Richter. *Ibid.*, xix, Ht. 1, 1861.	1861	Placenta prævia, convulsions.	In labor. (Prolapse of cord and hand. VII-para).	Fourteen hours.	Dead child between thighs.	Inversion and prolapse of uterus. Body putrefied.	....

Case No.	Author and Reference.	Year.	Cause of Death.	Duration of Pregnancy.	Birth of Child—Length of time after Mother's Death.	Condition and Position of Child.	Condition of Mother's Body, after Birth.	Unusual Conditions present at Birth.
59.	Pachur. *Med. Zeit. für Heilk.*, 1839, No. 34.	....	Sudden death.	(IIpara). Labor begun.	Twenty-six hours.	Child and placenta lying between thighs.	....	....
60.	N. Nikitin, Tomsk. *Sammlung über ger. Med.*, etc. St. Petersburg, 1875.	1871	Cholera.	Sixth month.	Four hours.	Child half expelled from vulva.	....	....
61.	Meyer. Schmid's Jahrbücher, 1855, I.	1853	Pleuro-pneumonia.	Sixth month (IIpara).	Fifty-two hours.	Child free outside genitals. Placenta adherent to uterus.	Not decomposed.	....
62.	Schenk. Hufeland's *Journ. der Pract. Heilk.*, April, 1821.	1814	Phthisis.	Ninth month.	Forty-eight hours.	Child found lying between thighs.	....	....
63.	Ebel. *Journ. der Pract. Heilk.*, June, 1822.	... .	Malpractice.	From 2 to 3 weeks before end of term.	After several days at medical examination.	Child between thighs. Placenta loose, outside genitals.	Body decomposed.	No signs of birth observed 3 days after death.
64.	Klaatsch. *Zeitschrift für Staatsarzneikunde*, 1819.	1819	Poisoning by arsenic.	Seventh month, no sign of labor.	After one month at medical examination.	Child between thighs. Placenta in vaginal canal.	Inversion and prolapse of uterus. Rent in fundus.	Decomposition advanced.
65.	Ebertz. *Viertel. f. g. M.*, Bd. (N.F.) xlvii, 1887, p. 171.	....	Suspicion of poisoning.	Eighth month (primipara).	On third day. No signs on second. Med. exam. on fourth day.	Fœtus enclosed in membranes, head toward vulva. Cord twisted around neck.	Uterus prolapsed with placenta attached. Putrefaction advanced. Mass distended with gas between legs.	
66.	Bleisch. *Vier. f. ger. Med.*, 1892, Bd. iii, p. 38.	1891	Labor (attended by midwife).	Labor begun (second stage).	Autopsy on third day.	Male child between legs, attached by cord to partially free placenta. Back upward, feet to vulva.	Putrefaction advanced. Uterus prolapsed and inverted outside vulva. Labia maj. distended by gas. Uterus inflated.	
67.	Moritz. *Vier. f. ger. Med.*, 1893, Bd. v, p. 93.	1892	Labor (attended by midwife).	Labor begun.	Autopsy on 38th day. No signs of birth on 3d day.	Male matured child. Back upward. Head near mother's knees. Body attached to part by free placenta.	Uterus completely extruded, inverted and distended by gas. Rent in peritoneum. Putrefaction advanced.	
68.	Malin. *Wochens. für gesam. Heilk.*, 1834, No. 12, p. 186.	1833	Shot through heart.	Fœtal movements were noted after death.	After a short time (interval not stated).	Child born dead.	....	....

being possible during life under unskilful manipulations, *e.g.*, in the common practice of midwives of dragging on the cord to free the placenta from its attachment. A glance over the table will show how often this extrusion of the uterus from the external genitals occurred when there seems no reason to doubt that it was due to the pressure of putrefactive gases alone (cases 47, 49, 58, 64, 65, etc.). It is well to note also the fact of rents being formed in the uterine and even the abdominal walls through the same means (cases 18, 47, and 64). This might as reasonably be charged to malpractice as inversion and prolapse of the uterus. It seems probable that this accident would have been more frequently noted, if autopsies had been performed in each case. When the birth occurred before burial, the accompaniment of a noise (*Geräusch*) was not uncommon, due in all probability to the rush of gases through the vent thus offered (cases 6, 10, 14, 15, 16, 22, 34, etc.). The period of pregnancy seems to have little effect in influencing the occurrence of post-mortem delivery; it takes place with the same ease, apparently, in such a condition as prolapse of the child's hand at full term (case 58), as in the fifth month of pregnancy (case 27); in primiparæ (cases 43, 46, etc.) as in women who have borne ten children (case 40). The birth of twins was noted quite a number of times (cases 1, 5, 18, 38), a fair proportion of the number of births. Inversion of the uterus took place quite frequently without accompanying prolapse (cases 26, 27, 40); in case 47, prolapse was the only condition present; but the two were most often coincident (cases 45, 49, 58, 64, 65, 66, and 67). The interval between death and birth of the child varies between limits which compel assignment of different causes for the latter event. Dethardingius gives the shortest space of time (case 13) recorded, one half-hour, and from this, the interval lengthens into ten days (case 37). It might be said that the earlier writers are apt to report inaccuracies in such circumstances, but the number of instances are too great (cases 1, 13, 15, 16, 22, 25, 36, etc.) to permit a doubt of the possibility of birth a few hours after death. While the authors of our own century do not appear to have observed so short a lapse of time as one or two hours, Baudelocque (case 36) records a birth after five and Darby (case 51) one after seven hours, too short a period for decomposition to have proceeded so far as to generate gas enough to expel the child.

Causes Assigned for Occurrence of Post-Mortem Birth.

Three theories, according to Aveling,[1] have been advanced in explanation of the phenomenon. The first is that it is caused by the contraction of the uterine walls in *rigor mortis.* This seems hardly worth consideration, for the contractions are not sufficiently powerful to overcome the natural obstacles to the passage of the child, with the superadded narrowing and rigidity of the parturient canal from the same cause.

The second theory is that to which we have had occasion to refer repeatedly—the pressure of putrefactive gases in the abdominal cavity, acting on the point of least resistance, expelling the fœtus and pushing the uterus before it until it lies outside the genitals distended with foul-smelling gaseous products (see cases 65–67). There can be no doubt that this explanation is the true one in a majority of instances, but there still remains a class of cases which it will not cover, since the birth took place too early for decomposition to have advanced so far as to produce sufficient pressure of gas.

To cover this ground, a third cause has been proposed in the conservation of power in the uterine muscle for some time after death (two hours is the limit generally placed). The contractile irritability, preserved after death, has been noted by various writers. Fodéré[2] says that "the uterus may expel the fœtus after death, its organic action being conserved after dissolution has taken place." Baudelocque[3] found the uterus contracted after a lapse of a few hours in a woman whom he had delivered immediately after death. Arbeiter[4] found a like condition of affairs, delivery of the child having been accomplished by version and extraction three-quarters of an hour after death. During the operation, the uterus was flaccid, but it contracted later into a hard ball. Leroux[5] cites a case of the same character, and others are on record. The uterus is often said to be the last portion of the body to lose its power of contraction and the last also to undergo decomposition. (See Diagnosis of pregnancy.) It is possible then to believe that, when birth occurs within a few hours after the mother's death, the force retained in the involuntary muscle of the walls of the uterus is sufficient to complete the labor.

---

[1] Trans. of Obs. Soc. of London, xiv., p. 240, 1872.

[2] "Méd. Lég.," vol. ii., p. 11.

[3] "Dict. des Sciences Méd.," xxx., p. 388.

[4] Monats. f. Geburtsh., April, 1862.

[5] "Traité des Pertes de Sang."

Can the Fœtus Live after the Death of the Mother?

While we may be permitted a doubt in such a case as that of Reiss (see cases 2 and 26), in which a day passed before a living child was born, according to the author, the answer to the question must be in the affirmative when the interval is only an hour or less. In the discussion of Aveling's paper, Dr. Madge[1] stated that he had observed fœtal movements after death in several cases and wished to extract the child by Cæsarean section, but was not permitted. Brunton,[2] after a quarter of an hour, extracted a living child from the mother's corpse. Buffon and Shierig have taken living animals from the bodies of female beasts, hours after death. The writer has done the same in the case of a fox. Aveling,[3] after citing some instances of a more or less doubtful character, closes with that of the Princess Swartzenburg, sister of the Austrian ambassador at the court of Napoleon, 1810, which he describes as the most celebrated. She was burned to death late one evening in her brother's palace, and the next day a living child was taken from her body by the Cæsarean operation. If this is true (and from the position of the parties, color is certainly lent to the statement), eight or ten hours is not too long a limit to be placed upon the life of the fœtus in utero after the oxygen supply from the mother is cut off, and the cases of the older writers (cases 1, 14, 15, 16) will appear more credible.

For instances in which living children have been extracted in from fifteen to thirty-two minutes after the mother's death, see also Breslaw, *Monatsch. für Geburts.*, B. 20, s. 62; Pingler, *Monatsch. für Geburts.*, B. 34, s. 244 u. 251; Botherston, *Edinburgh Med. Jour.*, April, 1868, p. 930; Welponer, *Wiener med. Presse*, No. 1, 1879; Buckel, Trans. London Obstet. Soc., XIX., p. 179.

---

[1] Trans. Obs. Soc., London, xiv., p. 240.

[2] *Ibid.*, xiii., p. 88.

[3] *Ibid.*, xiv., p. 240, 1872.

SEXUAL INCAPACITY

IN ITS

MEDICO-LEGAL RELATIONS.

BY

IRVING C. ROSSE, A.M., M.D., F.R.G.S.,

Professor of Nervous Diseases, Georgetown University; Membre du Congrès International d'Anthropologie Criminelle, etc., etc.

IMPOTENCE AND STERILITY.

PRELIMINARY OBSERVATIONS.

From time immemorial questions of impotence and sterility have occupied the attention of physicians and naturalists, priests and legislators.

Historical chapters in ponderous latinity may be found among old folios devoted to this subject. Even that classic master, Zacchias, from whose volumes so many medico-forensic writers have quarried, devotes several columns of his index to this subject alone.[1]

These questions, though varying according to the epoch, have taken medical and sociological importance in late years, and consequently have assumed a more scientific direction and development.

As disease leads to individual death, so does loss of genital capacity to that of the race. In its family and common relations the small number of births in France, for instance, is an economic subject that assumes alarming proportions. Even among the most prolific people in the world, those of Great Britain, it is estimated on high authority that 500,000 married women are sterile, or in other words that an average of twelve per cent of the marriages are unproductive. Statistics as to the lack of fecundity are not available in our own country, where this unhappy cause of so many empty households doubtless exists to the same extent. But as an offset to the sterile families, who would like to obey the Biblical injunction of increase and multiply, there prevail among others neo-Malthusian ideas of prevention and check and the crime of abortion, which are subjects of more alarming magnitude.

Although impotence is much more frequent among men, sterility is found in one woman out of eight, according to the statistics of Simpson and Spencer Wells, and when a marriage is sterile it is, nine times out of ten, the woman who is to blame.

---

[1] "Pauli Zacchiæ quæstionum medico-legalium opus absolutissimum. In tres tomos divisum." Francofurti M·DC·LXVI.

As impotence and sterility are often confounded, a correct notion of these terms is desirable. Definitions of various lexicographers, when sifted, result in attributing to *impotence* the impossibility of accomplishing the sexual act, and to *sterility* the impossibility of having children.

The difference may be explained by citing a few examples. A man, for instance, would be impotent, though not sterile, when the secretion of spermatozoids coincides with the absence of desire and the impossibility of erection, that is sometimes observed after prolonged excess or in cerebro-spinal troubles.

On the other hand, there is sterility, and not impotence where a physical obstacle to impregnation exists in a man with congenital or other defect of the penis, although all his virile faculties are intact; and the same would be true of an individual who has suffered from gonorrhœal epididymitis, notwithstanding the completeness of the venereal act; for in such cases the sperm may have lost its reproductive qualities, as it often does. Further illustration is to be found in adult castrates, in whom virile desire with turgescent penis may persist for years in spite of absolute and incurable sterility.

In women there may be impotence and not sterility, or reciprocally. The first is proved by the facts of pregnancy without intromission, as in unbroken hymen, and in the records of old trials, when suits for frigidity were so common, that women with malformations opposed to coitus have been found pregnant in spite of the husband's alleged failure of sexual power.

Though unable to conceive, it has been noticed that women are not less apt after the menopause. In fact, they are sometimes more ardent. In exceptional cases after oöphorectomy, the venereal desires and sensations are preserved. Such subjects though absolutely sterile are not impotent.

In impotence the venereal desires are present, but are wanting in *anaphrodisia* or *frigidity*, which is not so extended as impotence. All these terms apply to either sex, but some authors limit *impotence* to men and *sterility* or *agenesia* to women.

QUESTIONS RELATIVE TO IMPOTENCE AND STERILITY THAT MAY BE THE OCCASION OF INQUIRY.

Impotence and sterility in either man or woman may become subjects of medico-legal inquiry in circumstances that involve questions of medical deontology; or the civil law may have occasion to call on the medical jurist in determining questions relative to adoption and contested paternity, in granting a decree of nullity of marriage, in cases of alleged adultery, and in divorce cases; while criminal law may invoke the aid of medicine in special investigations where impotence is claimed to be the result of wounds or injury, or in cases where this condition is presented as an excuse or extenuation for various overt acts, as accusations of rape or unchaste conduct, and those arising from unsound mental states.

RELEVANT ETHICAL CONDITIONS.

Several instances of a deontological nature may present themselves in which nice points arise as to doubt and conscience concerning conduct. For instance, in a case of obstinate vaginismus, or of emotional epileptiform attack, that has resisted all treatment and forms an absolute bar to the act of copulation, would a resort to sexual intercourse under the influence of a narcotic or during anæsthetic sleep be justifiable? Ether has been given in such conditions, with the consent of the two interested parties, and fecundation has resulted. In the accident known as *penis captus*, an instance of which was lately reported in a medical journal, it became necessary to chloroform a housemaid who was the cause of getting a footman in this unfortunate predicament. A similar case is reported to have occurred a few years since in Washington.

A question may also arise as to the morally binding or obligatory nature of an operative procedure to cause artificial fecundation as the last resort in certain cases of sterility. Inability to impregnate a woman may arise from other causes than that of impotence or loss of power to copulate on the part of the man. Displacements of the uterus and alteration or deformity about the neck of this organ may prevent the entry of the impregnating fluid; while a man with hypospadias has the power to copulate and ejaculate normal sperm, yet is unable to fecundate. Moreover, in the case of a man who, from loss of the penis or other material obstacle, is thereby rendered incompetent to fulfil the copulative act, the histological elements may still possess fecundating powers. In other words, both the spermatic and ovarian functions are present, but owing to original defect in the reproductive organs of one or the other sex, the generative act cannot be effectuated in common.

It is in just such cases that artificial fecundation gives paternity to the man or brings maternity to the woman, accordingly as the operation is employed to overcome impossible coitus or to introduce seminal fluid, which would otherwise be lost, into the uterine cavity, where it becomes at once profitable.

Since the physician is supposed to combat sterility by all the medical and surgical means in his power, the advocates of artificial fecundation claim it as a justifiable therapeutic measure that may be used legitimately and without compromising either professional dignity or morality. On the other hand, the operation is condemned as a social danger, chiefly on moral grounds, which seem more specious than real upon disinterested investigation. Why the manœuvres of artificial fecundation should be more repugnant or indelicate than those attending a case of confinement, the introduction of a vaginal speculum, or caring for the female genital organs after the daily manner of gynecologists, is not clearly shown. The question is purely a medical one that has lately been taken from the domain of casuistry by people of the Latin race, among whom exists a considerable literature bearing on the subject.[1] Among English-speaking people the operation has been successfully practised by John Hunter, Marion Sims, and Gaillard Thomas; and there seems to be a general agreement among medical men who have given the matter attention that when the state of the man or that of the woman is such as to render impossible the material and intimate contact of the spermatozoids and ovules, the employment of artificial fecundation is authorized upon the express solicitation and consent of the two interested parties. The operation is, however, applicable to but a small number of cases, the indications for the performance of which may be left to individual judgment and conscience; yet certain circumstances occur in which civil stipulations may raise the question of artificial fecundation. The question was favorably adjudicated by the Medico-Legal Society of Paris, at its meeting on December 10th, 1883, in regard to a judgment rendered by the tribunal of Bordeaux.[1]

---

[1] See Gigon, Le Dr. P. F., "Fécondation Artificielle chez la Femme," Paris, 1871.

Among the cases in the United States Pension Office, many of which have been pushed to successful issue on less plausible testimony, is a claim for a widow's pension in which the claimant declares that at one of the battles of the late war she was a spectator, and happening to stand behind some soldiers was wounded in the abdomen by a ball that had previously wounded one of the soldiers in the testicles, from which she became pregnant and was delivered of a boy. What purports to be corroborative testimony bearing on the case, is the allegation that the boy subsequently underwent an operation for lithotomy, when a conoidal musket-ball was removed from the bladder.

Somewhat analogous to the foregoing are cases of tribadism in which an unmarried woman becomes pregnant through another woman, who from committing the simulacrum of the male act with her just after copulating with a man, brings into conjunction the histological elements.

A remaining question, connected by natural consequences to the utilitarian conception of medical ethics, is that of administering aphrodisiacs. Such substances may be prescribed by way of treatment with all the resources of therapeutics, medical or surgical, that may render possible or facilitate the exercise of the reproductive function; but the limit of duty is passed when in a special case and with a particular end in view the physician tries to provoke for a moment either a premature or an extinct function. While there is some diversity of opinion as to forcing the hand of nature by artificial fecundation, there seems to be a unanimity in condemning all efforts to provoke development of youthful instinct in a subject not yet arrived at puberty, or in the case of old age to bring back all at once the lost function, even though it might appear in the legitimate end of fulfilling conjugal duty. The general opinion is that a medical man degrades himself in prescribing what may be dangerous remedies for such a purpose; he becomes an accomplice of those devoted to criminal pleasures, and thereby puts himself in a way to merit the contempt of law and decorum.

---

[1] Annales de Gynécologie, vol. xx., December, 1883.

DISPUTED SEXUAL CAPACITY AND PATERNITY.

Civil stipulations may raise the question of impotence in the case of a husband who urges his genital incapacity as a proof of adultery on the part of the wife, who became pregnant at a moment when the husband, in consequence of physical accident or moral impossibility, could not cohabit during the legal time of conception. This impossibility, physical or moral, would be one of the conditions of disavowal of paternity when a woman guilty of adultery hides the birth of the child from the husband, whose allegation of impotence in such an event would be an act that destroys the presumption of paternity. Disavowal of the child cannot, however, be based on the alleged impotence alone. Since the law recognizes that an accidental and physical cause may destroy genital power, an expert examination becomes necessary to determine the nature, the date, and the effects of this cause. Legal authorities do not specify the nature of the accident nor the causes of physical impossibility that may prevent the husband from cohabiting with his wife; but they admit the questionable legitimacy of a child born in wedlock when impossibility of intercourse or non-access[1] can be proved, or when it is in evidence that the physical accident hindering coitus has happened in the interval between the 300th day and the 180th before, and not including that of the birth of the child. According to Prussian law the impotence must be proved to have been absolute between the 310th and the 210th day before the birth. The necessity of this evidence is also established by the Italian Civil Code. This of course raises the additional question as to the normal period of utero-gestation, which, according to Blackstone, "being a matter of some uncertainty, the law is not exact as to a few days" ("Commentaries," p. 450).

The statute-books refer to the matter as "the usual course of gestation," "the course of nature," "the laws of nature," and these phrases have given rise to much discussion and opposing evidence. There is, however, a general consent among the best authorities that the average duration of pregnancy is about 280 days. This statement is based upon a careful summary of the experience of others, including Hippocrates, who agrees in the common reckoning of 280 days. The old English Code specifies 40 weeks as the limit of pregnancy; and in the celebrated divorce case of Lady Mordaunt, there appeared in her diary, against the date 27th of June, the entry "3d of April = 280 days;" and this was deemed an evidence of her guilt. In considering this subject it is well to bear in mind that the normal period of pregnancy may be shortened, or it may be protracted beyond the normal limit. It has been decided that an infant of five months is viable and may inherit; the Code Napoléon mentions 180 days; the Scotch law allows 168 days, while a court in the famous Jardine case decided against the accusation of incontinency where the child was born on the 174th day after marriage.

---

[1] A husband is not a competent witness as to non-access.

From the fact that the day of insemination is not necessarily the day of impregnation, it has been pointed out repeatedly that all statements as to periods of gestation lack substantial accuracy. Owing to this variability in duration, it is, therefore, impossible to fix a definite and absolute period of utero-gestation. (See PREGNANCY, LABOR, AND THE PUERPERAL STATE, Vol. II., 263–282.)

As regards accidental impotence in contested paternity there appears to be some hesitancy among jurisconsults who have examined the subject. Some hold the word *accident* to mean an external wound or injury of palpable material nature and not an internal affection or weakness, the result of disease; while others, with more show of reason, claim that illness, either sudden and manifest or grave and long-continued, may sometimes bring about impotence as absolute and prolonged as that from surgical lesion. The Roman law admits this as a moral possibility (*Vel si ex valetudine fuit ut generare non possit*); and it would seem a conscientious decision that attributes this impossibility as much to old age and valetudinary state of the husband as to absence from home and misunderstanding.

IMPOTENCE AND BASTARDY.

In cases of bastardy interested persons (that is, the child himself, the heirs, or the mother), may contest the paternity or the maternity by alleging impotence at the moment of conception of the child. This might prove a bar to recognition and subsequent legitimacy. Objection may be made on the ground that the father at the moment of conception of the child had not yet attained the age of fecundity or that he had passed it. Legitimacy may be further contested if the child is born more than three hundred days after dissolution of marriage. It would, however, be more just before pronouncing illegitimacy to consider the cases which go to show that pregnancy may be prolonged beyond the term indicated by law. A conception may date even from the night of death. The case is recorded of a consumptive who died on the following day. But in order to establish the presumption of fecundation *in extremis* the kind of death should be taken into account, as well as the nature, character, and duration of the disease. Otherwise it would be impossible to furnish precise notions as to the legitimacy of a posthumous birth, which may or may not have occurred within competent time after termination of coverture. The heirs of the husband may contest the legitimacy by alleging the accidental impossibility of cohabitation in the last hours of life. As a rule, the paternity of a child should be established by a preponderance of evidence.

Facts other than medical, as those relating to questions of identity, may be combined in the investigation of maternity where a woman by way of disavowal urges absolute sterility as a proof. An expert examination that should determine this and the absence of all outward and positive traces of pregnancy or delivery in child-bed would be conclusive.

SEXUAL INCAPACITY AND ADOPTION.

The matter of genital incapacity also concerns the question of adoption in some countries, as in France, where it is not permitted before fifty years, if the health or bodily state renders likely the birth of a child. A similar law obtains in the German Code. The sterility must be shown before this age in order to get authority to adopt, except with special permission, when an expert examination becomes necessary. Casper reports that after a testamentary disposition, a man and wife not having the right to dispose of a capital, except at the epoch where it would be recognized that they were incapable of having heirs, he established the existence of this condition for the man and for the woman, aged seventy-three and sixty-three respectively. A law relating to adoption, and founded upon those of France and Spain, was introduced into this country by the States of Louisiana and Texas, but has since been abolished in Louisiana.

SEXUAL INCAPACITY AS IT CONCERNS THE DISSOLUTION OF A VALID MARRIAGE.

As a motive for the annulment of marriage or for divorce, impotence is of such medical and juridical importance that it is admitted as a cause by the law of most countries, and has consequently given rise to much discussion among jurisconsults and medical men.

Marriage being a *status*—a legal condition established by law—implies the ability to carry out certain conditions, the chief of these being the procreation of children. The laws of antiquity from the time of Moses show that this may fail through physical defect, as that of impotence, which easily permitted the breaking of a sterile union by divorce. Roman law had for its object the hindrance of sterile marriages; but with the advent of Christianity, and the recognition of the indissolubility of the marriage tie, as pointed out by the Evangelists Saint Matthew and Saint Mark, the laws of divorce became more and more restrictive. Yet the canon law placed impotence among the causes for dissolution of marriage, and its provisions relative to this question seem to have been subsequently adopted by the civil law.

Since questions of genital incapacity may complicate more or less the conditions that render marriage null and void, the facts that give rise to petitions for a sentence of nullity are considerable. Petitions are sometimes brought on the ground of "error in the person." Should two persons of the same sex be united to one another, rare instances of which have happened owing to a concourse of extraordinary circumstances, a union so monstrous is regarded not as marriage, but the simulacrum of marriage. Difference of sex being the essential condition of marriage, it follows that the absence of sex in one of the associates would be sufficient motive for pronouncing a decree of nullity. There are many precedents for this. A mixture of the two sexes in the same individual is also a cause of suspected civil state that may be rectified by nullity. But here it would be necessary to determine that the attributes of neither sex predominate, and that the impotence prevents either party from exercising the generative function. A further cause for nullity would be error in the sex of one of the spouses, a man mistaken for a woman or reciprocally. In such a doubtful case legal cause for the abrogation of marriage would be identity of sex, not error of the person. Such cases are only met with in so-called hermaphrodites, in whom the organic and functional vices of the procreative organs are owing simply to arrest of development. Individuals possessing this apparent sexual duplicity now come under the category of *monstrosities;* but the medical jurist cannot conform scrupulously to the classification of the teratologist, since for him there are but two genuses, the one a recognizable sex, the other indefinable and not capable of being identified. Still the coexistence in a single individual of certain of the genital organs and a blending of the anatomical peculiarities of the two sexes may render this individual incapable of acting in his or her proper relationship, and thereby be a motive for divorce. Such a case happened as early as 1654. A divorce was granted because the wife was a reported hermaphrodite.[1] For both physical and legal reasons, Chitty says in his "Medical Jurisprudence" that a charge or assertion that a party is an hermaphrodite is not actionable unless attended with actual damage. He cites the case of a dancing-master, who proceeded in an action for slander in calling him an hermaphrodite, in which it was decided that such action is not sustainable, as the words would not, in legal presumption, injure him in his profession or occupation.[2]

Medico-legal experiences in Continental Europe abound in cases where women wishing to get rid of a distasteful union bring forward the charge of impotence. This imputation, so easy to make, is acknowledged as a ground of divorce; but to be legal in English-speaking countries the impotence must be shown to have existed *before* marriage, and to be complete and incurable. The laws of some foreign countries extend the principle to impotence acquired during marriage. The Civil Code of Austria admits it as a ground for the dissolution of the relationship of marriage; while the German law, granting the same right to divorce, goes further in its liberality and extends the right to bodily infirmities that inspire disgust and repugnance or which hinder the accomplishment of conjugal duty.[1]

---

[1] Ed. Med. Jour., vol. xii., p. 77.

[2] 3 Salk, 397; Starkie on Slander, 143.

Petitions for divorce have also been founded upon the extent of conjugal duty, alleging that its too frequent or too rare accomplishment altered the health, or did not accord sufficient satisfaction to lustful desire. Ancient laws as to the frequency of sexual relations establish variable limits. Viewing the difference of opinion among such wise authorities as Mahomet, who says twice a week, Zoroaster every nine days, and Solon, who says every ten days, how are we of the present generation to lay down any hard and fast rule as to this complex question?

A matrimonial offence that may serve as a point of departure in a divorce suit would be the establishment of impotence[2] in cases of contested paternity. If the pregnancy was produced at a moment when the husband in consequence of absence from his residence, or from physical accident, was in the impossibility of cohabiting with his wife, this would be proof conclusive of the adultery, and therefore a valid ground for divorce. In the United States divorce is permissible for adultery and impotence; but the laws relatively thereto have been modified by the opinions of various judges and altered by legislative acts of the several States, each of which determines for itself the causes for which divorce may be granted; so that the frequent embarrassment arising from this diversity of jurisdiction prevents any general statement of the law. In most of the States, however, divorce law appears to have been founded on the doctrines of the common law, which allowed divorce *causa impotentiæ seu frigiditatis*, and with two or three exceptions this cause is mentioned in the divorce laws of all the States.

---

[1] Allgemeine Landrecht, sect. 697.

[2] A party naturally impotent cannot allege that fact for the purpose of asking divorce.

In seeking a divorce or sentence of nullity the law brooks no undue delay. In 1875, an English court dismissed the petition of a woman who had been married twenty-six years, because it was in evidence that she was an untouched virgin, and the respondent incurably impotent. A divorce on the ground of impotence was denied a husband who cohabited eight years with his wife, and delayed filing a bill until thirteen years after marriage (Peipho *v.* Peipho, 88 Illinois, 438). On the other hand, twelve years after marriage does not appear to have passed the limit in another case decided adversely to the husband, while in the remarkable divorce case of Lewis *v.* Hayward (35 L. J., P. M. and A., 105), the House of Lords held that fourteen years is not an unreasonable delay. Medical evidence showed the woman to be *virgo intacta et apta viro*, and the man apparently free from defect or malformation. In such cases the law deems insufficient the unsupported testimony of the petitioner. The person of the husband may, therefore, have to be subjected to expert examination, and in the event of his not forthcoming that of his wife, in order to determine the existence of the alleged impotence or sterility.

RELATIVE STERILITY.

Many cases, both in the lower animals and in the human species, bear out the admission that males capable of procreating in the case of one female may be sterile in the case of others. The physiology of this failure, both of production and exchange, is seemingly unexplainable. History furnishes examples of wanting sexual affinity or mental concurrence in the cases of Napoleon and Josephine, and in that of the Earl of Essex, who was sued by his countess on the ground of his impotence. Another celebrated case is cited in Hargrave's "State Trials," Vol. X., p. 24. The wife of John Bury alleged that her husband was impotent. On examination she was found to be a virgin and he to have but one testicle, the size of a small bean. The marriage was annulled. John Bury married again, and by his second wife had an issue. Dr. Ogston relates the case of two married couples without issue, who on a journey put up at the same hotel. The wives preceded the husbands to bed; but when the men retired, they respectively mistook their friend's room for their own, with the result that both women became pregnant.

In addition to the foregoing circumstances, impotence may be alleged in the suits for personal damage that are often brought against railway and other corporations. It is a matter of observation that impotence may follow profuse hemorrhage, and an old notion has prevailed since the time of Hippocrates, that bleeding from the vein behind the ear has this particular effect. An important estimate also attaches to traumatic lesions of the head and spinal cord. Concussion following blows on the head and nape of the neck have brought on impotence, and the case is related of a man in a railway accident, who escaped unhurt, but was so struck by terror that he was impotent for six months thereafter.[1] In the United States Pension Office many claims are filed for alleged impotence where there is no trace of wound or palpable lesion. A matter of fact bearing on this point is the experience of army officers, who have observed that a man of weak sexual instinct is always a poor soldier. Alleged disabilities plus the element of politics give rise to a peculiar pathology which for obvious reasons makes the medical adjudication of a claim of this kind anything but easy. In the absence of some visible, tangible, organic lesion justifying the supposition of impotence, no honest, conscientious physician could certify in such cases to the absence of virile and procreative power.

GENESIC INCAPACITY IN CRIMINAL AFFAIRS.

But in the matter of wounds or injuries there is material damage entailing a responsibility that may be taken into consideration and even become a question of fact of the highest medico-legal interest in a criminal proceeding. Legal redress may be sought in the case of impotence resulting from a wound, although the author of the act did not have that end in view. If it can be shown that impotence is the consequence of a lesion, it would increase the responsibility of its author and constitute an aggravation of the damage caused. Accidents of the kind are reported to have happened in the game of foot-ball, where loss of virility resulted from a severe kick.

---

[1] Roubaud, A. F.: "Traité de l'Impuissance et de la Stérilité," t. i., p. 186.

Even a tentative at maiming with a view to cause loss of procreative power is considered an offence assimilating a crime, although the object may not have been accomplished. The offence assumes the magnitude of a crime when the maiming has for its direct motive the abolition of the generative power. Such instances of mayhem are the castrations made by the "Regulators," "White Caps," and other bands who take the law into their own hands for the purpose of avenging or righting certain real or supposed outrages. A case of the kind happened some years ago during the Ku-Klux troubles in North Carolina. The victim on being taken to a lonely wood was forced to straddle a stump to which his scrotum and testicles were nailed. A knife being then put in his hand and a cocked revolver at his head, he was ordered, under penalty of instant death, to cut himself loose, thereby causing his own involuntary castration.

THE PLEA OF IMPOTENCE IN ACCUSATIONS OF UNCHASTE CONDUCT.

In accusations of rape and other violations of sexual morality, impotence is often alleged as defense. Here the medical jurist, in addition to noting local lesions, should estimate the proper value of such circumstances as the influence of age and disease, which may cause impotence more or less complete and lasting. A man of advanced age, to whom such a sexual irregularity is imputed, may claim to be incapable of having an erection, and demand an examination of his genital organs by way of verification. Should no alteration, either congenital or acquired, be found in the organs, the presumption is in favor of sexual capacity, unless there is evident general weakness and clearly defined valetudinary state. Since doubt counts for much in criminal matters, it is well to remember that anatomical appearances, as well as age and pathological condition, may not prove conclusively the absence of procreative power, which is presumed to exist until the contrary is proved. Exaggerated development or even normal conformation of the male genital parts do not always imply great functional activity, nor do they establish the existence of genital power, the only positive demonstration of which is erection, ejaculation, and normal constitution of the sperm. All of these may exist in subjects with insufficient development of the sexual organs. In fact small size of the male parts is not sufficient ground for inferring impotence, since a very small penis may coincide with energetic passion; and well-authenticated instances are recorded in which fruitful intercourse has been accomplished by individuals with very small penis and testicles, and even with one testicle not larger than a small bean. Moreover, it is common to find a diminutive penis in persons accused of sexual outrages. Conclusion from the general state may also prove as misleading as that founded on the irregular local conformation; for men of Herculean build have often less sexual vigor than little, slim, and nervous individuals. Friederich relates (p. 251) the case of a poor, anæmic, little man, having wife and mistress, who in his second marriage was the object of a demand in separation, based upon the violence of his excesses.

Advanced age in all such questions is only an indication that may or may not be completed by other proofs, since the mere fact of age alone does not imply absence of the procreative power. While admitting age as evidence of impotence, there are numerous examples of genital activity and of fruitful marriages in very old men, facetious remarks to the contrary notwithstanding. Historical and medical authorities furnish ample evidence of fathers at eighty. Schneider relates that a young girl of twenty-six was made pregnant by a man of eighty-six years. Mende reports the same fact of a man of eighty-nine years, married and the father of nineteen children; Sir Stephen Fox married at seventy-seven years, had four children, one born to him when he was seventy-eight, twins in the following year, and a fourth child when he was eighty-one. Haller admits the possiblity of paternity to seventy years and beyond. Example is cited in Massinissa at eighty years, of Vladislaus, King of Poland, at ninety years. Dr. Gregory, of Edinburgh, says that instances are cited of the retention of sexual vigor by men of upward of a hundred years old. The uncle of Felix Plater engendered at the age of one hundred and one years, and history relates that Thomas Parr was not only censured for incontinence at one hundred and eighteen years, but was a father in his one hundred and fortieth year. The legitimacy of Lord Banbury was questioned in 1813, the principal argument against him being that the ancestor under whom he claimed was eighty years old at the date of his birth. The House of Lords, before whom the case was tried, did not sustain the objection.

The finding of spermatozoids in the seminal fluid of very old men also lends confirmation to the assertion that advanced years in men do not imply sexual unfruitfulness, much less sexual incapacity.[1]

From the foregoing facts, and the statement of Sir Samuel Romilly, that the law of England recognizes no age to which is denied the privilege of having children, it is clear that no limit can be assigned by science or fixed by law at which the power of procreation ceases.

But the real question in a criminal accusation of this class may be one of infirmity rather than of age or deformity. Vicious habits and prolonged excesses may have brought on premature exhaustion of a durable nature, which would explain the absence of the spermatozoids in the seminal fluid as well as the loss of nervous energy necessary to bring about the venereal orgasm.

It has been argued upon insufficient data that spermatozoids are not necessary for the fertility of semen. Whether so or not, we could not establish impotence from this cause, unless it were accompanied by a state of general debility or anæmia, or some chronic disease resulting in profound nutritive change. Certain diseases, however, weaken or extinguish genital power, while others increase its activity or leave it intact. Many diseases may produce anaphrodisia. The most notable from which pertinent conclusions may be drawn are those affecting the state of the blood, as scurvy, anæmia, hemorrhages, and the general dyscrasiæ; chronic disease of the bowels or kidneys, dropsy, prolonged suppuration, and fevers. On the other hand, such diseases as piles, gout, gravel, rheumatism, certain affections of the skin and bladder, pulmonary consumption, and initial lesions of the brain and spinal cord not only leave the genesic sense intact, but in many instances are accompanied by satyriasis and sexual acts of an outrageous nature. I know of a case of locomotor ataxy in a man confined to bed, who had daily connection with the attending nurse. Another case coming under my observation was that of a dime-museum freak, so weak and emaciated as to be unable to rise from a sitting posture. Yet he assured me that he copulated nightly with the buxom woman who left the room after my arrival. Several physicians know of a child that a Washington practitioner was called to see. The mother directed attention to the frequent erections of the penis and queer actions of the child. Subsequent developments showed him to be a skatophagist of the most incorrigible kind; and it was also learned that the father, who was similarly affected during childhood, still indulged in the depraved habit.

---

[1] A recent case is reported of a man who contracted chancroids at the age of one hundred, and gonorrhœa at one hundred and three years. "Medical Review," May 5, 1894, pp. 355–56.

The relation of lost or weakened genital instinct to certain forms of nervous and mental disease is a question of great delicacy and difficulty. While more or less paralysis of the genito-urinary organs always follows obliteration or occlusion of the cerebral arteries, and inflammation of the brain and its meninges, yet in exceptional instances the generative function remains intact in advanced stages of nervous disease. Seminal emissions have been noticed in the last moments of hydrophobia, and in the permanent erection of cerebro-spinal meningitis, while the genital power, like a smouldering fire, often bursts out with fresh activity in some cases of locomotor ataxy, or mania, and even in dementia.

The generative function may or may not persist in individuals suffering from spinal sclerosis. It is generally absent in hemiplegia, but not always in paraplegia, unless the medullary lesion has affected the integrity of the genito-spinal centre. As a rule, genital power may be assumed to exist in sections of the spinal cord when reflex movements can be provoked; but when these motions are no longer possible, the presumption is that impotence is complete.

While the central nervous system influences the generative function both in a physiological and pathological way, on the other hand complete failure of sexual power acts upon the mental state, and may be the motive for various acts of a culpable nature. Remorse for past excesses and morbid fear may not only being on such psychic conditions as claustrophobia, panophobia, agoraphobia,[1] and the fear of a morbid impulse to commit some overt act, but may actually lead to delusional melancholia, and suicide.

---

[1] See writer's article, "Agoraphobia," "Ref. Hand. of the Med. Sciences."

As a matter of common knowledge all men admit that no bodily function is more under the influence of imagination and less under the sway of the will than that of generation. This fact, therefore, seems to suggest, if it does not establish, a coincidence between sexual neurasthenia and religious melancholia, between impotence and delirium of the imagination, and may account for and extenuate some of the outrageous sexual crimes in the initiatory stage of mental disease in very old men and irresponsible persons, who though culpable may in reality be impotent. (See SEXUAL CRIMES, Vol. II., pp. 737–762.)

THE CAUSES OF STERILITY AND IMPOTENCE.

From an etiological point of view the study of genital incapacity may be limited to the general causes that concern the two individualities in their reciprocal relations, and to the more special conditions affecting each sex in a separate capacity. In the present state of biological knowledge it seems impossible to account for many of the anomalies represented by a series of well-known facts that may be cited relative to this subject. All breeders of cattle and other animals are familiar with the atavistic fact of the females "throwing back"—that is, reproducing, after impregnation by a second male, the peculiarities of some other male by whom they had previously been impregnated. This has been observed in the case of bitches of pure blood fecundated by a cur, and subsequently by one of their own breed, when the second offspring is spoiled by its resemblance to the first. The same thing has been noted in horse-breeding. A mare covered by a zebra brought forth a hybrid zebra; impregnated subsequently by an Arab horse, she foaled in succession three zebra colts like the first male. Resemblance to the donkey is present in the colts of mares who have foaled a mule and are subsequently covered by a horse; and it is further observed that the mother of a mule conceives easier by a donkey than with a horse. These and analogous facts, it is thought, explain the infecundity attending the contact of two races of very different degrees of civilization, and account for the barrenness of aboriginal women, Australian for instance, who once impregnated by a European are afterward relatively sterile with men of their own race. Doubtless this may be one of many demographic facts to explain the disappearance of the procreative faculties of certain autochthonous races who yield to the vices and diseases of races superior in civilization.

The transmission of such biological pre-existences to the children of another union is apparent in the following case. The third of six hypospadians died a few years after the birth of his three sons. His widow within eighteen months contracted a second marriage, the husband in this instance not being a hypospadian, and having no history of any such defect in his family. By this marriage he had four sons, all hypospadians. Two of these hypospadic sons begat hypospadians in their turn. But one of these sons had three boys, without any offspring, although the eldest was a hypospadian. The physiological explanation may not be forthcoming, yet abundant analogy shows the imprint of the constitution of the father in such cases to be something more than a barren ideality. A man though dead may yet exert an influence over future offspring; and paradoxical as it may seem, the assertion of one who declared sterility to be hereditary in his family is not so absurd after all from an atavistic point of view.[1]

Many facts touching the causes of sterility do not, in the present state of knowledge, admit of scientific conclusion; yet it is a physiological law that whatever enfeebles the organism enfeebles its different functions. So that union resulting from degenerated individuals, the effects of various mesological conditions, as climate, age, nutrition, and sociological influences, may react upon the reproductive faculty of both sexes. The procreative age scarcely requires comment here; but puberty should not be confounded with the age of *nubility*, since the latter is a social and political consideration rather than a hygienic question. Most physicians know of the family and social blots resulting from the ill-assorted union of physiological bankrupts. It does not appear, however, from the researches and discussions of this much-controverted subject of the marriage of near kin that consanguinity in itself has the slightest action upon fecundity. Records show that marriages of cousins are not apt to be sterile. Dr. Tidy remarks that "whereas in the average of marriages one woman in eight is barren, in those between relatives only one in ten is so." Sanson says the influence of consanguineous marriages is to raise heredity to its highest power, and according to Lacassagne, it is not, in a word, the consanguinity in itself which is healthy or morbid, but the ground upon which it is exercised.

---

[1] See writer's article, "Atavism," "Reference Hand-Book of the Medical Sciences," and "Reversive Anomalies in the Study of the Neuroses," Jour. of the Am. Med. Assn. Sept. 8, 1888, also Fazio (Eugenio), "Tratato d'higiene," Napoli 2d Ed.; Bordier, A., "La Géographie Médicale," Paris, 1884, pp. 567–572, and pp. 542–547 this volume.

The influence of *hybridity* upon procreative aptitude is still a controverted question. Some anthropologists contend that crossings improve races; others that they always deteriorate. But this is an influence that seems to vary according to race and species. A mulattress has been known to have by a negro two mulatto children and eleven real negroes, and a negress to give by a mulatto nine black children and two mulattoes, while a negro has had of a white seven mulatto girls and four white boys. While the tendency in successive generations of mulattoes is to revert to the negro type, as instanced among the motley population of the West Indies,[1] it is generally admitted that mulattoes are deficient in procreative powers among themselves, and have not the same power of survival as the unmixed and more favored races.

In some cases of hybridity it is difficult to say whether the degenerative phenomena of sterility are owing to the miscegenation or to climate, as in Java, for instance, where the mongrel of Dutch and Malay gives rise to a curious mode of sterility, which manifests itself in the third generation, who are mostly girls and almost always sterile.

Meteorological influence is also a factor in causing sterility. Mamelukes in Egypt have never succeeded in creating a family with women of their own race. Non-acclimated Europeans in certain tropical countries become almost constantly barren in the second generation. This is notably so in the West Indies, where Frenchmen do not acclimate and flourish as they do for instance in Canada, under the same isotherm as Denmark; and Dr. Rochoux declares that French families not from time to time recruited, become extinguished in the third or fourth generation.[1]

---

[1] See writer's "Neuroses from a Demographic Point of View," Jour. of Nervous and Mental Disease, July, 1891, also a translation of the same in Archiv. de l'Anthropologie Criminelle et des Sciences Pénales, 15 Janv., 1892, No. 37.

Extreme cold also appears to influence genesic aptitude, as noticed in the small fecundity of the hyperborean races. Two seasons spent among the Innuits enable me to verify this statement, especially among the Eskimo of Bering Strait.[2]

Many writers, admitting the influence of the seasons, assert that man, like other vertebrates, is subject to the phenomena of rut, and that conceptions, rapes, and sexual outrages are more numerous in spring. Just as this periodicity diminishes in animals under domestication, so have the social habits of civilization rendered less apparent the influences of the return of spring upon the genital sense. It has been noticed by many Eastern people that the climate of California has a tendency to arouse erotic sensibility among recent arrivals. On the other hand, a Californian tells me that he is sexually frigid until he comes East, when the opposite condition prevails. Army medical officers stationed at Fort Monroe, Va., observing the increased fecundity and the ease of the child-bearing function among recent arrivals at the post, have been so impressed with this fact as to mention it in a special report to the War Office. A diet of fish and tea is offered in explanation.

Doubtless a change from the cosmic influences of a frontier post and improved nutrition may account for the increased procreative aptitude, since so much proof shows the intimate relation existing between the functions of nutrition and generation. Gastric disturbances may often occasion anaphrodisia; notable diminution in the number of births occurs after times of famine and privation; or the procreative power may be absent in the opposite condition of exaggerated nutrition, as in the case of extreme obesity. From time immemorial the obesity of castrates has been noted, as well as the concurrence of sterility and obesity in old prostitutes. Why women of this class are so seldom impregnated is a fact difficult to explain. According to one set of statistics 100 married women give 311 births, while 100 prostitutes furnish only 60, that is to say nearly six times less. Others say that while the married woman has one child in the proportion of 18 to 100, the free prostitute has 3 to the 100, and the registered prostitute only 1 to the 100. The frequent occurrence of metritis and pelvic cellulitis, and the oft-repeated chemical destruction and other influences taken as a means to prevent impregnation, bring about a want of special excitability of the neck of the uterus, which may account for this diminished erotic sensibility and the form of sterility in question. Promiscuous intercourse is not, however, a permanent cause of sterility, since many prostitutes on marrying and stopping their trade, become pregnant under the relative repose of the organs.

---

[1] See writer's "West Indies," "Ref. Hand-Book of the Medical Sciences."

[2] See writer's "First Landing on Wrangel Island with some Remarks on the Northern Inhabitants." Am. Geog. Soc., N. Y., 1883.

Several authors report examples of the absence of erotic sensibility in women who have had many children, while others report cases in which the voluptuous sensation was suddenly awakened by some obscure action of the nervous system after many years of inaction.

IMPOTENCE AND STERILITY IN WOMEN.

The part taken by woman in the function of reproduction being more complex than that of man, it results that the absence of progeny in a household is imputable to her in most cases. Sexual incapacity in woman, though not so interesting from a physiological point of view as that in man, is nevertheless a subject of greater medico-legal importance.

To notice in detail all the causes of sterility and impossibility of coitus would be to touch upon the leading topics of gynæcology. Many of the influencing conditions have already been named in discussing the circumstances in which the question may be one of medico-legal inquiry. The special causes that bear on the subject are congenital and other defects, pathological conditions, the action of drugs and poisons, and the influence of age upon the ovarian function.

It is difficult to say just at what epoch of life ovulation begins and ends, since Graafian vesicles have been found not only in the new-born but in the fœtus, and in exceptional cases the uterus and ovaries may retain their function till seventy and upward (See IDENTITY, Vol. I., p. 897). Orfila cites a case[1] in which the catamenia continued until ninety-nine. Girls have been impregnated at seven and one-half, eight, nine, ten, and eleven years, while late pregnancies have occurred at fifty-five and fifty-seven years. The Registrar-General of Scotland reports the case of a woman who gave birth to a child in her fifty-seventh year. Haller speaks of sixty-three and seventy years; White of seventy-three and seventy-seven, and in Genesis xviii. 2, we read that Sarah conceived at ninety years.

With such variable limits, the extremes of which may rather be looked upon as scientific curiosities, we are not warranted in fixing an age at which impregnation may not occur, as has been done in England; where several Vice-Chancellors have decided that fifty-three and fifty-five years exceed the child-bearing age. In an almost identical case, however, Vice-Chancellor Wickens declined to act upon the presumption that a lady of fifty-three would not have a child (Conduit *v.* Soane). The subject is one respecting which much litigation has ensued.

The menstrual state in such cases furnishes the best guide for determining the procreative aptitude, which as a rule begins with the first flow and ends with the menopause or disappearance of the menses. But as a matter of fact the fruitful period depends upon the connection between menstruation and ovulation. It is incontestable that menstruation may occur without ovulation. Although, as a rule, they occur more or less together, abundant evidence is recorded to the contrary in the cases of women who have become impregnated before the appearance of the first catamenial discharge; of others who ceased menstruating during their child-bearing life, and again of others who conceived long after the menopause.

From the study of a large number of statistical observations it appears that the first menstruations occur between nine and twenty-two years, and that the catamenia cease between forty-two and forty-eight. But the exceptions to these rules are so numerous that it seems impossible to fix an absolute age before or after which we should be justified in pronouncing an adverse opinion as to the fecundity of any woman.

---

[1] "Méd. Légale," t. i., p. 25.

STERILITY FROM CONGENITAL AND OTHER DEFECTS.

Among the signs of impossible ovulation and incurable sterility, absence or rudimentary state of the ovaries is a special anatomical element which appears the most obvious; but during life these anomalies can only be suspected, not affirmed, as there is no certain sign for their detection. Some of the other physical causes traceable to the uterine appendages may escape detection during life. Removal of the ovaries leads to absolute sterility, yet in a few cases menstruation continues and the sexual appetite remains. Numerous statistics attest the fecundity of women with one ovary, who have given birth to four and five children, twins, and even triplets.

Other insurmountable obstacles in the way of vicious conformation which cause absolute sterility are occlusion of the abdominal ends of the Fallopian tubes, imperforation of the neck or of the body of the uterus, absence of the uterine cavity, and congenital atrophy or even absence of the uterus.

Though implying absence of menstruation, entire absence of the uterus does not necessarily imply absence of sexual instinct. Owing to the fact that such a defect prevents complete copulation, a marriage was set aside in the case of Drane *v.* Aveling (1 Robertson, 274). In most cases absence of the uterus is associated with absence of the vagina or some abnormity of the external genital organs. Divorces have been granted because of one or more of these causes, and the existence of such a malformation as absent vulva or vagina seems to be an absolute impediment.

As to sterility from small size of the uterine organ gynæcologists are not in accord. By some the sterility of "pubescent uterus" is considered incurable; while others admit the possibility of a cure and ultimate fecundation. In the case of robust subjects art may remedy this condition. Operative procedures may also remedy such defects as a voluminous and elongated clitoris and nymphæ as well as atresia and closure of the vagina, and thereby head off the domestic infelicity that ultimately leads to separation or divorce.

Vesico-vaginal and recto-vaginal fistulæ are additional causes of genital incapacity in women. The three orifices of the vagina, rectum, and urethra forming a common opening has been observed in a non-viable individual. Impregnation has, however, been observed in one case of vagino-urethral deviation.

The foregoing defects are barriers to marriage, yet the question of advisability of marriage, which a physician may be called on to decide, should not be hastily discouraged or forbidden, since each case may have merits of its own. The real issue in cases of congenital defect is not so much a question of copulation or impregnation, but rather the possibility of remedying the defect by operation. A court has held that the husband was entitled to a decree in a case where the woman might probably be cured if she submitted to an operation involving no great risk of life, which operation she refused to undergo. From a legal point of view such a condition is deemed equivalent to a permanent and immovable malformation that would hold valid in the matter of divorce.

PATHOLOGICAL CONDITIONS OF STERILITY.

Deformity of the pelvis from rickets, causing narrowness that prevents entrance of the penis, is a cause that has been judicially admitted. Sexual relations may also meet with hindrance in vaginal stenosis resulting from disease or injury; from an imperforate hymen; from tumors of the labia majora; and from elephantiasis of the external genitals. Uterine diseases and displacements, though ordinary causes of sterility, are not always absolute obstacles, since many of them are curable, and impregnation has been known to take place in a case of procidentia observed by Chopart. Catarrh of the uterus, affections of the uterine appendages, and general constitutional affections, as syphilis, tubercle, scrofula, heart disease, obesity, and functional nervous diseases of obscure nature, are also considered as causes of sterility.

The action of drugs and certain toxic substances are thought to be causative factors. It is quite possible to bring about a general neurasthenic condition with wasting of the ovaries by iodine and the iodides; and the absorption of certain substances, as the sulphide of carbon, may also diminish the genesic faculty, while the gonorrhœal virus may bring about the same condition; the action of many other so-called anaphrodisiacs is problematical in the extreme. Notwithstanding the great learning and research brought to bear on the subject, it is impossible in some cases to find any pathological conditions to account for the sterility.

IMPOTENCE IN MAN.

Frequent causes of impotence, as extremes of age and other defects, being already mentioned, in discussing the circumstances in which sexual incapacity may become the subject-matter of inquiry for the medical jurist, it is not necessary to recapitulate to any great extent.

Natural absence of the penis or of the testicles is an obvious physical condition that would seem to preclude regular and natural copulation. Yet the absence or malformation does not necessarily imply impotence, since the conditions sufficient for impregnation exist in some such cases, and the possibility of causing fecundation without coitus should be kept in mind. Nor do the opposite conditions of enormous size, bifurcation, or double penis justify a charge of impotence, although they might of sterility. Many Eastern medical students of twenty years ago may recall the Portuguese with three legs and double penis, both of which he asserted became erect during copulation.[1] I have lately examined and had photographed a singular case of duopagus penis in the person of a German, a former cavalryman of the United States army. The two organs were soldered together as one sometimes sees in fingers or toes, and the end of the glans was divided by a slit-like opening with labia and other characteristics of the female external genitals. This man also assured me of his sexual capacity, which had not been exercised in late years, owing to the pain attending the act.

Irregular erection from shortness of the frenum may also prove an obstacle to impregnation by diverting the ejaculation in a manner to prevent fecundation. Absence of the urethra or imperforate penis would, however, be more positive obstacles.

The question involved in all such cases is one of degree; for minor degrees of hypospadias and epispadias are consistent with paternity, the incontestability of which is attested by heredity and atavistic facts that have been noted by different authors since the time of Zacchias. Moreover, gonorrhœa has been observed in a patient with epispadias; and in the case of a hypospadic boy of seventeen summoned on a charge of affiliation the paternity was affirmed, notwithstanding the plea of the defence that it was impossible for him to be the father because of this infirmity.[1]

---

[1] Annals of Gynecology, Nov., 1888, p. 100.

While the absence of genital power from extreme degrees of the foregoing malformations does not admit of much discussion, there are, however, cases in which it would be impossible to say positively whether impotence or even sterility exists.

Congenital absence of the testicles in the imperfect state of non-descent, where these glands retain their abdominal or lumbar position, presupposes the establishment of impotence; but many substantive facts testify to the contrary. Not only have spermatozoids been found in cryptorchids, but paternity in several instances has been imputed to them, as well as accusations of rape and sexual immoralities.[2] It therefore seems that retained testicle is not in itself an absolute bar to marriage, an infallible evidence of non-paternity, nor a proper ground for divorce, notwithstanding the rule that cryptorchids as a class are non-prolific.

No exception can be taken in the case of a subject with but one testicle. A case is cited of a monorchid condemned and executed for rape following murder. A man in Washington with the same defect—if it can be so-called—has a family of ten children.

INFLUENCING CONDITIONS ARISING FROM ACCIDENT AND DISEASE.

The genital gland being the only trustworthy characteristic of sex, there is consequently no sign that attests the absolute extinction of the procreative function so well as extirpation of the testicles. Nevertheless, in castrates the power to copulate in a small degree sometimes persists, and there is even a possibility of fruitful intercourse taking place. A case is recorded of the many sexual misdemeanors of four castrated soprano singers who were banished from a small Italian town. The possibility of fecundation rests upon the fact of recent castration after puberty; the discovery of semen in the vesiculæ seminales; upon the analogies in animals, and upon instances in man. Sedillot cites a case in which a man became a father after the removal of both testicles[1]; and in Henke's *Zeitschrift*,[2] a husband is reported to have impregnated his wife after losing both testicles from a gunshot wound. There seems, however, to be some doubt as to the correctness of the observations on this subject; and the evidence is further complicated by the possibility of only a small piece of the healthy gland remaining intact, which it is clear would not warrant the assumption of sterility.

---

[1] Med. Times, Sept. 21st, 1850, p. 321.

[2] Quatrefages, Thése de Strasbourg, 1852.

Traumatic lesions may also arrest the functions of the testicle. Violent contusions have been known to bring on rapidly this condition.

An accident or an operation causing entire absence of any intromittent organ would in all probability result in impotence, but such a person, though rendered incompetent to copulate, may be able to impregnate, for reasons already assigned in dealing with artificial fecundation.

A scrotal hernia may be the manifest cause of incurable impotence, especially where it is of long standing, irreducible, and so large as to surround the penis. Elephantiasis may similarly affect. Hydrocele, phimosis, and paraphimosis, being only temporary obstacles, are not admissible causes. But it is possible that surgical operations for the relief of these conditions may lead to impotence and sterility, as in the case of lithotomy.

Pathological atrophy of the testicles following measles and mumps is said to bring about a condition analogous to the arrest of genital development known as *infantilism*. Cases of orchitis or epididymitis followed by atrophy appear to be more common among the Latin races. In 452 cases of parotiditis among soldiers, Laveran has observed 156 of orchitis, 75 of which were followed by testicular atrophy. Prolonged statistical search as to the atrophy of these organs in such cases fails to show that impotence is common from this cause either in England or the United States.[3]

---

[1] Manual, p. 17.

[2] 1842, vol. i., p. 348.

[3] In a late epidemic among Indian troops a medical officer of the U. S. Army has observed thirty per cent of epididymitis.

UNNATURAL CRIMES.

BY

IRVING C. ROSSE, A.M., M.D., F.R.G.S. (Eng.),

Professor of Nervous Diseases, Georgetown University; Membre du Congrès International d'Anthropologie Criminelle, etc.

If it can be established that cancer or sarcocele has completely destroyed the two glands, impotence may be assumed to exist. Other diseases of the testicle, as abscess, tubercle, and double epididymitis from gonorrhœa affect more or less its structure and prevent spermatogenesis. Many other causes hidden to the observer, such as closure of the ejaculatory canals, hardening of the veru montanum, and engorgement of the prostate escape examination, and for that reason have no definite place in legal medicine.

Among the more frequent cases of impotence and sterility that come under observation, especially that of the neurologist, are those in which the organs are intact. They usually result from early and prolonged excesses, either of a natural or unnatural character, and are practically incurable. Signs of decrepitude and loss of bodily power from general disease may sometimes come within the category of *doubtful* cases of sterility. Many physicians know that syphilis may induce sterility without appreciable lesion of the genital organs, yet the fruitfulness of many syphilitics is unhappily a notorious fact. A just medico-legal estimate of the foregoing remarks is summed up in the case of a noble Roman who thus exposed his scruples to Zacchias, when pressed to marry in order to perpetuate his race: "*Brevitas penis, œtas, quœdam ignavia aut segnities, quondam morbus gallicus.*" On discussing these motives the doubts were dissipated by the physician, and a marriage was brought about which was fruitful.

A paralytic old man of eighty-four years is cited by Taylor as a case of disavowal of paternity which was admitted.

Many other pathological causes of impotence and sterility come within the domain of the later researches in psychiatry and neurology. But the law, following in the wake of medicine, may not recognize them at the present juncture, and a court may be slow or even refuse to make a decree in cases where such questions are involved.

EXPERT CONCLUSIONS.

Certain signs furnished by necropsy may remove doubts and enable the investigator to form correct conclusions. But the advance of science renders it possible to establish the absence of genital power in the living with a reasonable amount of certainty. The medical jurist has nothing to do with proving its reality, as this power is assumed to exist until the contrary is proved. In conducting an examination for this purpose there should always be a witness present, and if the conjoints are to be examined it is best that the same man should not examine husband and wife. The local examination should not be made without the consent of the person, and in case of refusal the consequences are purely legal. All gross or indecent manipulations of the genital organs are to be avoided, for the reason that they are unnecessary. Although conducted with system and scientific decorum, the examination may lead to a most guarded opinion; but in most cases medical knowledge, good sense, and conscience may enable the medical jurist to form a just conclusion.

UNNATURAL CRIMES: SEXUAL INVERSION; BESTIALITY, PEDERASTY, TRIBADISM.

GENERALITIES.

It is said that all the motor forces of life may be reduced to two, namely, the preservation of the individual and the continuance of the species. Notwithstanding the fact that these great incentives are more or less modified or transformed in appearance by civilization, it requires but small reflection to recognize the truth and wisdom of the assertion concerning what are at bottom the source and spring of most human actions.

Aside from volitional incitation, the sexual, in common with the other appetites, is influenced by the activity of the cerebro-spinal centres, as witnessed in the well-known effects of imagination in this respect; while all the senses, smell, sight, sensation, etc., act with a certain amount of energy upon the genital sense itself, which, moreover, presents the same morbid anomalies as other functions of the body.

Since each author has treated the subject from his individual point of view, clinical, anthropological, or medico-legal, there is far from being unanimous accord as to whether or not anomalies of the sexual instinct are pathological manifestations. The matter of sexual criminality is one that has perplexed magistrates, jurors, lawyers, and medical experts, and has troubled the conscience of judges. Its study, really polyclinic in scope, touches upon questions of social pathology, teratology, mental alienation, and morbid psychology. While history and physiology teach that sexual crimes are marks of weakness and decadence, there is a more recent tendency among scientific men and medical jurists to place them in the category of abnormities, since the facts show that such manifestations ordinarily occur in degenerate individuals in whom the sexual instinct is the point of least resistance. It is now generally admitted that the majority of such cases are owing to hereditary predisposition, and that their phenomena are essentially pathological. Such appears to be the present status of the question among genitalists. In fact Krafft-Ebing, Charcot, Rabau, Magnan, Kowalewsky, Moll, Bourneville, Gleg, Tournowsky, and other authors are unanimous on this point. Different writers also admit that these syndromata of nervous heredity in their different forms may develop spontaneously, or they may be provoked by such agents as the license of literature and the stage, the privation of women, excess and separation of the sexes; and may range over a curious and monstrous field all the way from examples of indecent exposure or exhibitionism up to the hideous crime of profanation of the dead.

It is an error to suppose that sexual crime is confined to any species, time, race, or social class. Evidence shows that unnatural crime exists under all latitudes. It extends from the prehistoric time of the troglodytes up to Hippocrates, who brands it in his oath, and from his time to the present, when a prurient public is regaled with the sexual litigation of divorce and breach of promise cases, club scandals, and the filthy reports of the journals. Only of late one may find in looking over the medical journals cases of bestiality reported in such widely different places as Buda-Pesth and Philadelphia; while it is estimated by one authority that questions relative to the sexual instinct and to the function of reproduction count for three-fifths of the law cases in France. M. Lacassagne, professor of legal medicine in the University of Lyons, who has collected 2,500 cases with complete details, says that such cases become more and more numerous, and that they form a good third of those tried in the court of assizes. According to another authority, in 1888 there were 25,000 adult uranists in Germany, while Moll estimates 4,000 male sexual perverts in Berlin alone. Compared with New York, Chicago, or San Francisco, for instance, the much-exaggerated Pompeian evidences of unchasteness dwindle into insignificance. If one of our large cities were suddenly destroyed and the records of such matters left, the persons reading them might correctly infer that Pompeii was only an adobe village in comparison. The prevalence and spread of sexual crime, therefore, merits scientific study, to the end that both clinical and legal medicine may have clearer knowledge on this point.

German investigators, with characteristic methodical exaggeration, have introduced many new and confusing terms and elaborate classifications which tend rather to obscurity for purposes of forensic medicine.

Nosologically the subject of unnatural deviation of the sexual instinct may be considered under three categories, namely:

1. *Abolished* sexual function, as in impotence or agenesia;
2. *Exaggerated* or extreme sexual passion, known as *satyriasis* in the male, and as *nymphomania* in the female;
3. *Perverted*, as in the phenomena of uranism, fetichism, massochism, and sadism.

In the interest of terminology it may be well to define the last-mentioned, which are merely complications of sexual inversion.

By *uranism* is meant the violent sexual passion that an individual conceives for one of the same sex. "Greek love" is a synonymous term.

Fetichism,[1] the venereal excitement caused by part of the body of a woman other than the genital organs, or by objects of an insensible nature, as a piece of her dress. *Azoöphilia* is another term to express this morbid feeling for insensible objects, or those of an inanimate nature, a statue for example.

Massochism is that state of perversion in a man whose greatest sexual enjoyment is to feel subjugated and even maltreated and beaten by a woman.

Sadism, the opposite of massochism, is a combination of voluptuousness and cruelty, in which the sexual inclination manifests itself by the desire to beat, to maltreat, humiliate, and even kill the person for whom the passion is conceived.

Violent sexual passion of an individual for another individual of the same sex is known as *Sexual Inversion*.[2] It is also spoken of as *homosexuality*. Such morbid attraction among men is known as *pederasty*, and among women as *tribadism*.

---

[1] Binet: "Le Fetichism dans l'Amour," Paris, 1888.

[2] A phrase now used by the best writers to express this reversal of the natural order of things. See Charcot and Magnan, also Tamassia: "Sul l'Inversione del Istinto Sessuale," Riv. Sperim., 1878, pp. 97–117; Chevalier, J.: "De l'Inversion Sexuel au point de vue Médico-légale," Lyon, 1885; and Zuccarelli: "Inversione Congenita dell Istinto Sessuale" Napoli, 1888.

The manœuvres of either sex to produce the venereal orgasm independently of the conditions of normal coitus, and known comprehensively as genital abuse, appear from many startling clinical facts to prevail to such an extent as to call for more extended study. The question is one of social hygiene, touching mental pathology on many points. There is consequently a call for better understanding by physicians and lawyers as to specific acts, since medico-legal intervention may require consultation and advice to pass upon the mental state and responsibility of an individual, in order to determine whether a certain act is the result of unsound mind or merely one of a libidinous nature. A physician, reading over the laws relating to unnatural crimes, cannot resist the conclusion that their incompleteness is owing to the want of clear and explicit medical knowledge of the subject. On the other hand, to many members of the medical profession the particulars of the afore-mentioned acts are totally unknown, while many others, actuated by virginal modesty or from feelings of false delicacy, shrink from exposing the turpitude they constantly meet with. It is not then astonishing that the "apostles of purity" have censured physicians for neglect and backwardness in dealing with such matters. The late Archbishop of Canterbury, in a sermon a few years since, before the Medical Association at Birmingham, reproached the medical profession with a want of courage and candor in dealing with the whole question of "purity," so-called. Even the authorities on crimes and misdemeanors allude to the subject as "an infamous crime that strikes at the root of society, a heinous offence so horrible as not to be named among Christians,"[1] and other like phrases of a vague nature.

We shall therefore depart from the reserved and concise mode of statement heretofore adopted, and shall not hesitate to turn the search-light upon these unpleasant professional details.

THE PROHIBITION OF OBSCENE PUBLICATIONS AND THE LIKE.

Several important practical questions as to causes, prohibitory and repressive measures, and the like, have lately claimed the attention of legislators and others. Only last autumn we read of the "Congress against Impure Literature" held at Lausanne. It has been suggested that the subjects of genesic inversion may be the victims of an anomaly analogous to that of splanchnic inversion. Whatever may be the cerebral blot or abnormality of the genito-spinal area that brings about this physiological instability, there is at the present time a subtle and powerful influence in corrupt and immoral publications, indecent advertisements and newspaper articles, printed and pictorial, which tends, by concentrating the thoughts on the lower portion of the genital tract, to bring about much sexual depravity. The erotic effect of reading publications of the kind may affect the lower lumbar reflexes in such a way as to cause great anxiety, and bring about sexual hypochondriasis;[1] not to mention the fact of their influence as wide disseminators of immorality and as teachers of crime among the young, immature, ignorant, and sensually inclined; a class that constitutes by far the largest proportion of every community. The Sapphic literature that is yearly vomited forth by the Continental printers recently caused the railway book-stalls in Belgium to be closed. In English-speaking countries, societies for the prevention of vice have brought many of these human vampires of the printing-press to the attention of justice. Cases in point are the well-known action against Bradlaugh and Besant[2] for publishing "The Fruits of Philosophy," and the recent prosecution of Messrs. Vizetelly for publishing "Nana." Notwithstanding the "Indecent Advertisement Act" passed in England, failure to convict is the rule in such cases. It is probable that no thoroughly effective legislation will ever be brought about, and that such indecent publications as "The Elements of Social Science,"[3] quack advertisements entitled "Health, Vigor, and Manhood," and the outrageous reports and meretricious illustrations of newspapers will continue to appear in countries where speech is free and the liberty of the press unrestricted.

---

[1] Russ, Cr., section 698, also Bacon.

---

[1] See writer's "Sexual Hypochondriasis and Perversion of the Genesic Instinct," Jour. of Nervous and Mental Disease, November, 1892; also Virginia Medical Monthly, of same date.

[2] Convicted of the misdemeanor of publishing an immoral pamphlet, and both were sentenced to a term of imprisonment by the then Lord Chief Justice; but both managed to escape what many considered a merited punishment by a technical informality.

[3] "Earthly, sensual, and devilish," according to Dr. Agate in "Sexual Economy as taught by Charles Bradlaugh, M.P.," London, 1893.

Prosecutions for sending obscene matter through the mails in violation of the Federal Statute (sec. 3,893, Rev. Stat.) are of frequent occurrence.[1]

An additional provision prescribes a penalty for United States officers aiding the violation of the law, who "shall be deemed guilty of a misdemeanor, and shall for every offence be punishable by a fine of not more than $5,000, or by imprisonment at hard labor for not more than ten years, or both."

Even scientific and medical publications may come under the ban of condemnation and form the basis of a prosecution, if wantonly exposed in the open markets, with a wanton and wicked desire to create a demand for them and not to promote the good of society by placing them in proper hands for useful purposes.

A French publisher[2] was lately arraigned before a Paris tribunal for outraging public morality by publishing a translation of Moll's work on "Sexual Perversion," in violation of the law of August 2d, 1882. The gravamen of the charge, however, appeared to be that the work in question was "an infamous book whose German origin called particularly for severe repression." The defendant was acquitted.

In Chicago it is also complained with some show of reason (that is, demand for the book and its wanton and open sale to improper persons), that Krafft-Ebing's work on the same subject is debauching in its effects and panders to lascivious curiosity.

EXHIBITIONISM OR INDECENT EXPOSURE.

Among the milder forms of unchaste conduct that come within the sphere of forensic medicine are cases of indecent exposure. The question here arising as to just what constitutes an obscene act or gesture clearly depends upon circumstances. It is held that the public exposure of the person is most obscene, yet the necessary exhibition of the person to a physician is not only innocent, but is a proper act, dictated by positive duty. The condition determines the quality of the act. Thus the nude in art is not of necessity indecent, but it may be so conditioned as to come under the ban of condemnation.[1] Reports show that most persons charged with the crime of obscene exposure are old men of no occupation and of unsound mind. Exceptions, however, occur in the shameless exposure of girls afflicted with hysterical mania, imbecility, or nymphomania; and I know the case of a German boy in Baltimore, who was arrested and fined upon the complaint of several ladies who lived opposite to a club-house where he was employed, and from the window of which he daily exposed his penis to them in a lascivious manner. A German of forty years has just been sentenced in Washington for six months, for indecent conduct before several small girls in one of the public parks.[2] Indecent exposure may also be charged to innocent and absent-minded old men, who may be suffering from some local irritative disease that causes the frequent application of the hand to the sexual organs or the anus. Many persons may recall the case of an old professor of mathematics at a celebrated school on the Hudson River.

---

[1] Some of the cases falling within the provisions of the statute are: United States *v.* Morris, 18 Fed. Rep., 900; United States *v.* Gaylord, 17 Fed. Rep., 438; United States *v.* Hanover, 17 Fed. Rep., 444; United States *v.* Button, 17 Fed. Rep., 731; United States *v.* Bennett, 16 Blatch., 338; United States *v.* Harmon, 45 Fed. Rep., 414; United States *v.* Smith, 45 Fed. Rep., 476; United States *v.* Clarke, 38 Fed. Rep., 372; United States *v.* Chesman, 19 Fed. Rep., 732.

[2] Affaire Carré, contre le Ministère Public. Audience des 12 et 19 Juillet, 1893.

SEXUAL CRIMINALITY IN ANIMALS AND BESTIALITY.

If crimes of sexuality were confined to the human species, we should not have an opportunity to study the biological beginnings of vice as observed in curious instances in animals, which incline us to ask whether these inversions of the genesic instinct are with them unnatural phenomena or rather an outward manifestation of an imperious functional want. Without exposing the details of the analogy upon which is founded the presumption, we are warranted in saying that as many of the lower beings in the zoölogical scale show virtues having analogy to those of man, we must expect to find parallel vices. Instances of sexual perversion have been observed in insects, turkeys, dogs, stallions,[3] elephants, and other animals. I have witnessed such manifestations among animals in the Regent Park as well as in the Washington Zoölogical Gardens, and I learn from trustworthy persons connected with these places that genital abuse is common among animals deprived of their liberty.

---

[1] United States *v.* Smith, 45 Fed. Rep., 476.

[2] Washington Post, May 11th, 1894.

[3] In the United States Patent Office is an electrical appliance to prevent self-abuse in stallions.

It would be easy to multiply similar instances, which may be suggestive from a Malthusian point of view. We know that the female spider often kills and eats the amorous male; female birds will combine to drive away the male, and other analogous facts have been noticed in various species, such as that of sadism in a certain variety of southern lizard, the female of which on finishing the copulative act immediately kills the male and chews off his head. Whatever may be said of animals in this respect, the facts of zoölogy tend to support rather than antagonize our moral code. It is rather in the matter of bestiality that sodomitical intercourse with animals claims the attention of the medical legist.

Unnatural Relations with Animals.

The carnal union of man or woman with an animal has always been regarded by legal writers as "an infamous crime and misdemeanor." It is mentioned as one of the special crimes known as *Sodomy*,[1] by which lawyers mean "carnal knowledge committed against the order of nature by man with man; or in the same unnatural manner with woman; or by man or woman in any manner with beast."[2] The term sodomy is rather an inappropriate, mystical one, much employed in the Middle Ages by religious writers, and belongs rather to ecclesiastical than scientific style.

Bestiality, or lust for a living being of the opposite sex other than human, is regarded as high treason against humanity and a crime against the species. Happily, at the present day this monstrous sensual depravity belongs rather to history and to the study of mental alienation. The penal codes therefore show a discreet silence upon this crime, doubtless imitating Solon, who in his legislation did not prescribe a penalty against parricide, a crime which he supposed impossible.

[1] For a legal *résumé* of the subject see "The Amer. and Eng. Encycl. of Law," vol. xxii., 1893.

[2] Russell: "Crimes and Misdemeanors," sec. 698.

Unnatural relations, forbidden by God and despised by man, are mentioned in the Bible from Moses to St. Paul.[1] They have, perhaps, existed from all time, as numerous citations from both sacred and profane literature go to show. In antiquity there were the sacred ram of Egypt; the serpents kept in the temple of Æsculapius, and the donkeys mentioned by Juvenal (Sat. VI., 332, 333), so much sought after by women who recognized the salacity of an animal that promised the most voluptuousness to hysterical insatiety. A quotation from Plutarch would seem to show that animal and individual relations of a culpable nature were widespread in the Latin empire; and from histories of the Middle Age we glean that the vice was more dominant than in antiquity. Soldiers in those days satisfied their passions on anything, mules, hogs, sheep, or fowls; and on the march, among the camp-followers, were richly caparisoned goats, kept for the use of officers and their friends.

It is not, therefore, astonishing that the frequency of the evil should have attracted the attention of theologians. In the fifteenth and sixteenth centuries, a favorite theme for sermons was sodomy and bestiality, as one will see who cares to run through the sermons of Jean d'Aquilæ, Savonarola, Cherubino di Spoleta, and others, not to mention the monstrous details to be found in the work "De Matrimonio" by Father Sanchez. Nor is it surprising that the question of unnatural fornication came up between confessor and penitent; that the matter should be mentioned in the *Regulæ Communes* (xxxiv.) of the Jesuits, and that penal sanction should be attached to bestial sin committed by a member of the clergy: "Item episcopus cum quadrupede peccans decem annos pœniteat, presbyter quinque, diaconos tres, clericus duos."

It is very easy to hurl anathema at another century and to say that such an epoch carries off the palm for corruption. In our day this crime, though less prevalent, is far from rare in the large cities. In France, Dr. Pouillet says, there are but few villages where the degradation does not exist among the inhabitants, and that cases of this kind are common in the courts of justice. Many persons who have done the slums of some of the European cities may recall performances between a woman and a donkey which were to be witnessed on paying a small sum. A similar show, in which a large Newfoundland dog and a prostitute were the actors, could be seen a few years ago in San Francisco. The passive agent on being questioned regarding this form of salaciousness, averred that if a woman once copulated with a dog she would ever thereafter prefer this animal to a man. The much-maligned Chinaman, who has the reputation of having reached the highest refinement of lubricity, is said to have such a partiality for ducks, that Europeans in China will not eat a duck on this account. As a race problem, however, it does not appear that the "fetichism of love" is more observable in the Mongolian than in the Caucasian. Personal observation in such matters in the Chinese quarter of San Francisco leads to the belief that the French prostitutes in an adjoining street are much lower in the scale of sexual depravity. Doubtless from an ethnic point of view there is a difference in the erotic constitution, and an Anglo-Saxon may not be capable of so much salaciousness as a Turk, an Arab, or a negro.[1]

---

[1] Judges, xix.; 1 Cor. vi. 10.

The crime of bestiality appears to have existed at all epochs among the people of the Occident, especially where polygamy prevails. Kocher[2] says that among the Arabs bestiality is common with goats, sheep, and mares. Cheevers[3] says that the crime is held in light esteem in the Punjaub, where men suffering from gonorrhœa consider that unnatural connection with a goat is a cure. From the same source it is learned that many ponies had to be killed by military authority, the Goorkahs being addicted to that vice.

In a case tried in England it was held that an unnatural connection with an animal of the fowl kind is not sodomy, a fowl not coming under the term "beast;" and it was agreed clearly not to be sodomy, when the fowl was so small that its private parts would not admit those of a man, and were torn away in the attempt.[4]

A man was arraigned in Henrico County, Va., for unnatural penetration of the body of a mare. The case being considered a "question of *novelty* and of some difficulty," was tried before several judges, who with that diversity of opinion that legal fiction assumes to exist among medical experts only,[1] did not agree as to the guilt or innocence of the accused.[2]

---

[1] Of all the races of men Annamites rank the lowest in sexual capacity and African negroes the highest. For this reason the negroes have been spoken of as *hommes étalons*, and the Annamites as *hommes singes*. The negro takes one-third more time to copulate than the white.

[2] "Criminalité chez les Arabes," Lyon, 1885, p. 160.

[3] "Med. Jurisp. for India," 1876, p. 706.

[4] Rex *v.* Mulreaty, Hill T., 1812, M. S., Bayley, J.

Another case of bestiality with a mare is to be found in 8 C. and P., 417.

The case of a negro boy and a cow, in a suburb of Washington, came under the observation of a medical practitioner and others. A few years since a young unmarried woman in the Capitol City was surprised *in flagrante delicto* with a large English mastiff. This was a matter both of police and medical knowledge. A similar case of "vaginitis from bestiality" is reported in the *Philadelphia Medical and Surgical Reporter*, July 22, 1893, p. 155, in which the culprit confessed to having unnatural connection with a dog. A case of bestiality with sheep is also lately reported in a medical journal from Buda-Pesth.

Among other genital idiosyncrasies of negroes coming to the knowledge of the Washington police is the old Scythian malady spoken of by Hippocrates and Herodotus, and observed by contemporary travellers in the Caucasus. A band of negro men, with all the androgynous characteristics of this malady, was some time since raided by the police upon information given by several medical students. The same race, a few years ago, had several gangs that practised a kind of phallic worship. An informant, who has made a study of skatological rites in the lower races, described a personal visit to one of these orgies, where a big negro with turgescent penis, decorated with gayly colored ribbons, stood and allowed his comrades to caress and even osculate the member. Performances of the same nature are known to the rites of voudouism. In New Orleans about the close of the Civil War, a voudoo society was suddenly surprised by the police during these ceremonies. Two of the naked persons taking part in the orgy were white women. The incident led to a famous trial which resulted in acquittal.

---

[1] Current reports from the court of last resort, the United States Supreme Court, show thirty-five cases disposed of with as many different opinions, concerning which occur the familiar phrases, "Bench pretty evenly divided," "Reverses its own decision," etc.

[2] 1 Va. Cas., 307.

THE PRACTICES AND MANIFESTATIONS OF PEDERASTY.

It is doubtful whether observations such as the foregoing lend support to the statement that in the progress of humanity lubricity and civilization march hand in hand, since travellers have noticed that many facts to the contrary exist among primitive people, especially our North American Indians. The early discoverers are said to have noticed sexual crime in Peru, which is one of the excuses given by the Spaniards for the cruelty of Pizarro to the natives. Having spent two seasons among the Eskimo of Bering Strait, I have reason to believe, from circumstances not necessary to detail, that inversions of the genesic instinct exist among these people just as they do among our common humanity in other latitudes. The sodomical habit referred to, known as *pederasty*, is one of the oldest infamies of the Adamic race, and one for which the Mosaic,[1] Roman, and Caroline laws inflicted the penalty of death. Only a short time ago, hanging was the penalty for this crime both in England and America.

Biblical and classical writings show the spread of a vice that could not be arrested by the voice of the Apostle, the edicts of magistrates, nor the penalties attached thereto by the Casuists. The historical development of this subject would form a long chapter of curious but repugnant reading. The worship of Bael was only a masculine prostitution, which is also expressly mentioned in the Koran,[2] and for which Mussulman jurisconsults have prescribed a most severe penalty. According to ancient Mohammedan law, the justification of homicide by the party upon whom this crime is attempted is expressly stated. Cases are mentioned by Stovarinus and Fryer, where the victims courageously took the lives of their assailants; their conduct brought them the commendation and protection of the public.[3]

History informs us that Philip himself was soiled by this infamy; Cæsar, according to Suetonius, was "the husband of all women and the wife of all men," and Nero, Alcibiades, and Adrian were addicted to the passion. Even Horace, in the latter part of his career, was accused of an attachment of the kind, and one of the poems of Virgil, which so many of us read as schoolboys, is full of pederastic allusions. From historical citations it would be easy to sketch the spread of pederastic prostitution in other epochs, especially about the fifteenth century, when religious mysticism and genesic insanity assumed monstrous proportions, or the geographical distribution may be referred to, which shows a greater prevalence in Asiatic countries. At Lucknow, in 1855, one hundred houses and an entire street were given up to pederastic commerce. Armenia is considered the focal point of a vice that prevails to a more notable extent in the Mediterranean towns than in other parts of Europe. But it is rather the modern epoch and places nearer home that concern more recent judiciary medicine.

---

[1] Leviticus xviii. 22, 23.

[2] Chap. vii., v. 79 and Chap. iv., v. 20.

[3] Cheevers (Norman): "Medical Jurisprudence for India," 1876, p. 709.

Rectal coitus between men and women is so prevalent in Paris, says Dr Pouillet, that out of every hundred prostitutes admitted into the Lourcine sixty, at least, have undergone rectal defloration (see Professional Stigmata, Vol. I., pp. 426, 427).

The concert of the two prostitutions, feminine and pederastic, is known to many. Persons familiar with certain streets of Naples after dark may recall the runners for prostitutes, who offer both feminine and masculine merchandise, and on being refused the proffered woman, offer a *bellissimo ragazzo.* Only a short time ago a notorious place of the kind in New York, known as the "Slide," was broken up by the authorities, mainly through the publicity given to it by *The New York Herald.*

A case in related in the law books of a man as pathic and a boy of twelve.[1]

Generally it is the boy who is the pathic or passive agent. From several prosecuting attorneys of the larger cities, I learn the details of many cases, and there has come to my knowledge an instance of a religious hypocrite, a man living in a village, who ruined a number of boys, three of whom died, and one committed suicide. A similar case, known to the police of Washington, is that of a well-connected man with a very pallid complexion, who enticed messenger boys to a hotel, and after getting them under the influence of drink accomplished his fell purpose. Syphilis is often transmitted by this mode of coition, a fact described several hundred years ago. Since the work of Binet (1881) on infecting chancres of the anus, Martineau has observed twenty other cases (Lacassagne). A noted pederast, tried a few years ago in Philadelphia, is said to have communicated syphilis to a dozen or more victims. Some years since I saw at San Francisco, on board the celebrated Arctic cruiser *Corwin*, a case of syphilitic periostitis in a ward-room boy, who had been shipped by the executive officer without inspection. Being too young to have acquired venereal disease in the ordinary way, examination revealed the existence of a horrible mass of syphilitic sores about the anus and nates. The boy confessed that previously to his shipping on the *Corwin* he had served on board the United States ship *Alaska*, where men had used him as a passive agent for immoral purposes. Dr. Dickson, United States Navy, reports a similar case that he has observed in an apprentice boy of fourteen at the Washington Marine Barracks.

---

[1] Reg. *v.* Allen, 2 C and K., 868.

BUCCAL COITUS—IRRUMATION[1] AND FELLATION.[2]

The presence of chancres being observed in other parts of the body, as the mammæ, the axilla, and even the mouth, calls for the consideration of a hideous act that marks the last abjection of vice. So squeamish are some English-speaking people on this point that they have no terms to designate the "nameless crime" that moves in the dark. Many of the Continental writers, however, make no attempt to hide the matter under a symbolic veil, and deal with it in terms as naked and unequivocal as the old historians, from whom hundreds of citations might be made, and this, too, without incurring the reproach of pedantry.

A quotation from Erasmus shows that *lesbianism* had a place in his thoughts: "Aiunt turpitudinem quæ per os peragitur, fellationis opinor vel irrrumationis, primum a Lesbiis authoribus fuisse profectam."

The writings of the Casuists, so profoundly versed in matters of conscience and human vice, show unequivocally the same thing, as witnessed in the question, recommended to spiritual directors, especially those of Bishop Burchard of Worms, in the eleventh century; and some ecclesiastical writers even went so far as to express the opinion that they saw no mortal sin in the action of "virile membrum in os mulieribus immittere," nor in that of "virile membrum in os accipere."

---

[1] These terms not being Englished, the following definitions are given: *Irrumare*—penem in os arrigere.

[2] *Fellatrix* dicitur ea quæ vel lingua perfricandi atque exsugendi officium peni præstet.

From writings of the genitalists references like these might be cited to a tiresome length; but to be brief, it may be said that inversions of the genesic instinct did and do exist among all people, and that numerous cases may be collated from current medical literature and from the archives of criminal anthropology and penal science. So prevalent indeed is this theme in literature that a prominent medical author says citations may be made from all the historians from Herodotus to P. Dufour; all the poets from Sappho to Baudelaire; all the naturalists from Aristotle to Mantegazza; all philosophers from Plato to Schopenhauer; all the romancers from Lucien to Sacher-Masoch, and all the law-makers from Moses to the Austrian legislators. A contemporaneous French writer says that "the fire and sulphur that destroyed Sodom and Gomorrah would scarcely satisfy to purify New Caledonia."[1] And Dr. Pouillet writes of buccal coitus that *irrumation* has become so habitual (*chez nous*) among the French that there are but few young men of this generation upon whom it has not been practised, and but few complaisant women or prostitutes who refuse to fill the office of *fellatrice.*[2]

As a reflex of this state of immorality it is only necessary to call to mind the unclean realisms of Zola, of Tolstoi, and of the French lesbian novels, "*Mademoiselle Giraud ma Femme,*" by A. Belot, and "*Mademoiselle de Maupin,*" by Th. Gautier, whose point of departure is tribadism. The same astonishing theme pervades "*Fridolin's heimliche Ehe,*" by Hildebrand; "*Brick und Breck oder Licht in Schatten,*" by Count Emerick Stadior, and "*Venus im Polz,*" by Sacher-Masoch. In our own country the surreptitious sale of such publications is carried to such an extent that agents of the Post Office Department yearly capture and destroy tons of pornographic literature. In fact so much obscene matter comes to the Dead Letter Office that the postal authorities prohibit women clerks from opening the mail. Certain benevolent societies co-operate in the matter of suppression; but many of their methods for preventing vice and bringing about prohibitory legislation, though well meant, are both impracticable and reprehensible. Over-zeal has led to false philosophy and sophistry like that of the prohibitionists, who would have enacted sumptuary laws that interfere with the liberty of the subject. An organic necessity so imperious in its promptings as the generative instinct may not be controlled or suppressed in many of its manifestations by legislative enactments. In fact such measures would be about as ineffectual as an attempt to change some of the great physical wonders of the North American Continent.

---

[1] For an account of these infamies see le Dr. Jacobus X—— "L'amour aux Colonies," Paris, 1893, pp. 267-313.

[2] See Luiz: "Les Fellatores, Mœurs de la Décadence," Paris, 1888.

That these degrading acts tend to spread more and more in the great centres of population, it is only necessary to recall what many have seen in the older cities of Europe, where women will commit the simulacrum of the virile venereal act for a small sum of money; where infamous scandals have occupied the attention of justice and the newspapers, and have even caused the expulsion of a member of Parliament, who is now in penal servitude for his crime. A vice that can hardly be said to have crossed the Atlantic with Columbus or with the austere pilgrims of the *Mayflower*, since the early explorers found it among the primitive inhabitants of Panama and Peru, has caused social scandal and lawsuits in New York, and murder and divorce in Chicago, San Francisco, and far-away New Zealand.

Perhaps it is more to the point in this respect to study the details of one's own city. What is true of Washington, for instance, as regards sexual matters doubtless applies more or less to American large cities.

A physician whom I see almost daily tells me of a case of venereal disease of the buccal cavity in an old soldier he is treating. The patient with unblushing effrontery did not hesitate to say how it was contracted. The medical details of various other cases reported to me by local physicians could also be recited.

From a judge of the District police court it is learned that frequent delinquents of this kind have been taken by the police in the very commission of the crime, and that owing to defective penal legislation on the subject he is obliged to try such cases as assaults or indecent exposure.[1] The lieutenant in charge of my district says that men of this class give far more trouble than prostitutes. Only of late the chief of police tells me that his men have made, under the very shadow of the White House, eighteen arrests in Lafayette Square alone (a place, by the way, frequented by Guiteau) in which the culprits were taken *in flagrante delicto*. Both white and black were represented among these moral hermaphrodites, but the majority of them were negroes.[2]

Another instance is that of a sanctimonious young man who frequented a certain religious association in order to entice victims of this singular abuse.

CONDITIONS AFFECTING SEXUAL INVERSION.

As to the influencing conditions of the morbid phenomena in question, age, sex, and station of life may be considered. Aside from such exclusive agglomerations as soldiers, sailors, and prisoners, sexual inversion does not appear to be confined to any degree of the social scale; yet the statistics in this regard go to show that certain callings furnish a greater number than others. According to the best authorities actors head the list, especially those accustomed to performing the parts of women.[3] Exceptions to the statement may, however, prevent one from generalizing in too absolute a manner, although Caspar and others are of decided unanimity on this subject, while Moll says that the only profession that seems suspicious in this relation is that of the actor disguised as a woman; that men who from preference take the rôles of women appear often to suffer from sexual perversions. The next in order of frequency come decorators, hair-dressers, and ladies' tailors. It is suggested by way of explanation that the peculiar inclinations of these individuals may result from the fact of their being morphologically male yet psychologically female. Others speak of abnormal distribution of the genital nerves to the rectal mucus, and of such individuals as psycho-sexual hermaphrodites, or, more speculatively, as suffering from some disturbance of the genital sphere, localized about the olfactory centre, which causes a lesion of this autonomy.

---

[1] It appears by the ancient authorities of law that this was felony (12 Co., 36). See also Sir James Stephens, "Crim. Law Dig.," p. 103.

[2] See McGuire and Lydston: "Sexual Crimes among the Southern Negroes," Louisville, Ky., 1893. Observation shows, however, the rarity of sexual perversion among the aboriginal blacks.

[3] Notably so in China, where they go further and play the rôle of woman *au naturel*.

It has also been observed among spiritualists, and mediums in particular, that one finds a large number of individuals exhibiting the phenomena of sexual perversion. Hartmann[1] and Moll cite late instances of successful mediums suffering from this malady. Religious instinct so often goes astray in this regard as to impress all philosophers and all physicians with the narrow blending line that divides religious exaltation and erotic perversion. Many hypochondriacs pass for religious when they are merely suffering from sexual neurasthenia; and it is a fact known to others than physicians that so-called religion and erotic debauchery often go together. For this reason much that is found in our "land of spiritualists, mesmerism, soothsaying, and mystical congregations" may be looked upon with suspicion.

By many the Jews were supposed to figure largely as sexual perverts; but lately published facts show the incorrectness of this supposition and even the smaller proportion than in other races. Compared with cases among individuals who help to make up the "Salvation Army," or with the evangelical performances in Brooklyn of *De Cobain*, now in penal servitude, there seems to be no difference between Jews and others in this respect.

Deviations of the sexual instinct have been observed from the age of sixteen up to eighty-two years. They are said to be more common in men than in women, Kraft-Ebing observing but 11 women out of 198 recorded cases. Other writers on criminality, disposed to question the correctness of the assertion, say that the graver forms of sexual inversion, either congenital or acquired, are usually met with in men, but the minor anomalies are more prevalent among women, owing to their greater affectibility. On the other hand, while pederasts show an aversion for the opposite sex, they are noted for effeminateness, falsehood and dissimulation, a tendency to hysteria, excessive prudery, and inordinate fondness for jewelry.

---

[1] "Nachträge zur Phänomenonologie des Unbewussten."

TRIBADISM.

If crimes of sexuality were confined to men, the lesbian habits of women would furnish no material for comment. There seems to be a difference among authorities as to the relative frequency of sexual inversion among women. Dr. F. Claye Shaw, speaking of the sexes in lunacy, says that in language women hold the palm for volubility, abuse, and foul-mouthedness. There is no difference in this respect between the barefaced virago from the lowest parts of the town, and the fashionable women from the best quarter.

Certain it is that noise, filthy conduct, and sexual depravity, both by speech and act, are much more common on the female than the male side of an asylum.[1]

According to Moll all sorts of sexual perversions are found among women, the one most frequently met with being inversion, in which the woman feels herself drawn not toward man, as she ought to do normally, but toward another woman. The act by which "*una fellat lingua clitoridem alterius*" has also received the name of *Saphism* from the poetess Sappho, who it seems is greatly libelled thereby, since the best critics think she merely wished to depict the tendencies of women in the Lesbian epoch. *Clitoridism* is a synonymous term applied to the act performed by a woman with exaggerated development of the clitoris, who uses this means to abuse her own sex.

The vicious habits of tribadism, like those of pederasty, are widespread, and have a history and ground of consideration of their own. In countries where harems and polygamy abound. saphism is a fashion that has long prevailed. Though an old vice, its scientific study is of relatively recent date.

It is difficult to say among what class or station of life tribadism most prevails. One of the wives of Henry VIII., Catherine Howard, is said to have been condemned to death because of homosexual habits; but like many historical anecdotes it is of doubtful authenticity, and not susceptible of proof.

Better established are the lately reported "biuterine marriages" and sexual relations between actresses, waiter-girls in beer gardens, and public women, among whom tribades are found in the greatest number. Dr. Moll says that he knows to a surety that twenty-five per cent of the Berlin prostitutes indulge in sexual relations with other women. Many cases of tribadism are also reported in married women, among whom liaisons extending over several years have resulted in breaking up households. A strange case of this kind published by Duhousset in 1877, is that of two tribades, one of whom after marrying resumed the liaison with her former friend, who became pregnant. Although a little mystifying, it is possible that the married woman in leaving the embrace of her husband for that of her friend transported a small quantity of fecundating fluid. Other cases of the kind are reported, but the details are not authentic.

---

[1] St. Bartholomew's Hospital Reports, vol. xxiv., 1888.

Analogous to the same feeling in the male sexual pervert, there exists on the part of the tribade indifference, antipathy, or profound repulsion for an individual of the opposite sex.

But, strange to say, homosexual women have not the same defects of character as male perverts; many of them having a horror of falsehood and of vice in general. Jealousy among them seems to be most powerful and ungovernable, even extending to murder at times. A case of morbid love in which one young women killed the other was tried on the eastern shore of Maryland a few years ago. The recent and well-known case of Alice Mitchell is still another in point.

Owing to the lack of facility in studying homosexuality in women, and the lesser number of facts relatively thereto, the details of this vice among them are not so well known as are those of pederasty in men. Many particulars as to the existence and spread of saphism have been learned by neurologists, who, it seems, are more accustomed than others to look into the muddy bottom of the heart and into the dark corners of human nature.

I know the case of a prostitute who from curiosity visited several women who make a specialty of this vice, and on submitting herself by way of experiment to the lingual and oral manœuvres of the performance had a violent attack of hysterocatalepsy, from which she made slow recovery.

Through a patient of the opposite sex, another case has come to knowledge of a woman who practises the orgies of tribadism with other women after getting them under the influence of drink.

A recent case of "neurasthenia," in which an unfortunate love-affair was suspected to be at the bottom, was that of a young woman, who after much hesitation confessed to me a liaison of the kind with a woman who was a "faith-cure" or "Christian Science" practitioner. The patient said that this woman with a sort of mesmeric influence had completely subjugated her will to the extent of making her break off a very desirable engagement of marriage, and that she was only one of several young women who had come under this fell influence.

A modification of this form of perversion, though mentioned by writers of antiquity, has lately been discussed in more recent works. Krafft-Ebing and Mantegazza mention instances of women who employ lap-dogs for a sensual end, and Moll reports that he was consulted by a married woman who, fearful of contracting disease, confessed the habit of allowing a pet dog to lick her genitals until complete satisfaction ensued.

Many instances like the foregoing might be cited with sickening detail from the annals of foreign medicine. Although it is true that the practices described are ancient and known to physicians and magistrates, yet judiciary medicine happily has but little to do with mono-sexual adultery, either pederastic or lesbian, in English-speaking countries. Besides, they are not a subject of legislation and seldom come before a court, except in the case of divorce, where the practice of unnatural crime is alleged on the part of the husband as a cause for granting a decree. Moreover, the vulvar and other deformities[1] described as physical characteristics of tribadism have not yet taken a recognized place in legal medicine.

POINTS TO BE OBSERVED IN REGARD TO THE EXAMINATION.

In the case of a charge of unnatural crime, the physician may find himself on a rogatory commission whose function is to determine whether the alleged outrage is a crime or merely a pathological phenomenon. An expert examination with this end in view should, therefore, be extra-careful and severe, and conducted with great reserve and even over-scrupulous prudence, since a single accusatory word from the physician may sound the note of infamy or lead to a suspicion that blights a reputation beyond recovery. From its nature, says Blackstone, the offense is so easily charged, and the negative so difficult to be proved, that the accusation ought clearly to be made out. The evidence should be plain and satisfactory in proportion as the crime is detestable.[1]

---

[1] Martineau: "Leçons sur les Déformations vulvaires et anales," 1884.

For this reason similar accusations against certain historic personages may be the calumny of enemies, which, in the absence of unequivocal proof, should be accepted with considerable reserve. In an accusation of this kind, the time of day when the offence was alleged to be committed should be carefully noted. In fact many of the precautions taken in cases of identity or in rape apply in a measure, as they may bear upon an *alibi*, for instance, or may in some manner lead sooner or later to the support or abandonment of the accusation.

Usually there is not much objection on the part of the accused to submit to medical examination. In case of refusal the expert should not insist, but merely point out to the individual the inconveniences that may result from the abstention, and he may note the refusal on his report.

Medical evidence, rarely asked for in cases of indecent exposure, is usually for the purpose of determining the existence of certain diseases, or of some form of mental unsoundness (see Tattooing, p. 905, Vol. I.)

Opinions of medical men have also weight with the postal authorities and others in regard to the distribution of obscene or indecent publications, which are held to be obscene libels, and for that reason non-mailable.[2]

A possible judiciary curiosity in connection with the subject is the suit of a man in Kentucky, whose grievance appears to be that another person called him "Breckinridge."

IN CASES OF BESTIALITY.

Unless taken in the act, the only medical evidence of value in cases of bestiality is the identification of *hairs* of the animal on the accused, or the finding of suspicious spots, stains, etc., upon the clothing. It may, however, be difficult to prove that the origin of the several spots is one and the same, or that the blood corpuscles or spermatozoids discoverable by the microscope are those of man or some other animal.

---

[1] Blackstone, "Commentaries," 215, p. 926.

[2] 2 Wharton, "Cr. Law," sec. 2,545; also Com. *v.* Landis, 8 Philadelphia, 543, and R. *v.* Hickling, 3 Eng. L. R., Q. B., 360.

In Cases of Suspected Pederasty.

Suspected seminal spots and fecal matter on the undergarments do not avail much as evidence in alleged pederasty, although with corroborative proof they may be of importance in supporting the charge. In conducting an examination in a suspected case of this nature it is well to get all possible information as to the antecedents of the accused; his genealogy, history, present health, general appearance and habits, intelligence, and all signs of degenerescence.

The genitals, the anus, and nates call for special examination with a view to finding the pederastic signs that may throw light on the active, passive, or mixed criminality of the person charged.

The medical appearances said to be the result of pederasty in the *active* male criminal are relaxed and pendulous sexual organs, elongated penis, with bulbous and conical glans, and twisted urethra.

In *passive* criminality the supposed characteristics are redness, excoriations, fissures, tears of the anal region, with effacement of the folds and smooth appearance of the skin of the part, a peculiar funnel-like depression of the anus with relaxation of the sphincter, and incontinence of the feces.

In the *mixed* forms the effect of both active and passive criminality are united.

Many of these signs are, however, by no means specially characteristic and are at times absent even in notorious criminals. They may also result from other than criminal practices, as the sequel of a surgical operation or a real infirmity. On the other hand, it should be clearly understood that the absence of these signs is not absolute proof of the non-commission of the crime. The only form of conclusive medical evidence possible in such cases appears to be the finding of a gonorrhœal discharge, or a chancre within or at the verge of the anus. A medical witness should therefore depose as to the suggestiveness only of certain appearances, which may have occurred from natural causes, and he should be content merely to state whether or not, in his opinion, they are consistent with the commission of the crime.

The question of tribadism rarely comes before a court. Many are inclined to look upon this practice rather as a social monstrosity, which like incest carries with it its own just punishments in the form of prompt mental and physical degeneration, and does not properly come within the range of legal medicine. Besides there are no characteristic appearances by means of which the commission of the act may be proved.

Supposing the guilt established, a more delicate and difficult question arises as to the mental state and responsibility. This of course depends upon the signification furnished by the symptoms to be gleaned from the study of social and individual causes, and mesological conditions; from the defects of organization, as vice or arrest of development, lesion of the nerve centres, heredity, femininism, and other factors concerned in the production of the anomaly.

If a manifest hereditary state can be established, showing instinctive impulses in young age with important nervous or psychopathic troubles, a fair and reasonable conclusion may be reached as to the criminal responsibility of a subject of sexual inversion. The anomaly is the manifestation of a grave state, which Westphal first appears to have regarded as a morbid episode dependent on mental aberration. Others now recognize this hereditary neuropsychopathy or inborn, sickly disposition, which impels to acts that the will is powerless to repress, and consequently brings about irresponsibility. It is held that such phenomena are irresistibly morbid; that a patient of this class is not a culprit, but rather a lucid fool to punish whom would be a misconception and an anachronism.

From the criminal point of view the expert should bear in mind that he may have to deal with exaggerated charges, simulation, and attempts at blackmail. Cases of this kind have occurred in which the accusations were totally false and unfounded. Taylor, mentioning the case of a man in Jamaica, sentenced for life for an alleged crime of this nature that he had committed upon the plaintiff during sleep, expresses the opinion that the accomplishment of such an act during natural sleep is contrary to all probability.

It appears from different legal authorities that it is not necessary to complete the act to constitute the offence, since the mere soliciting another to the commission of the crime has been treated as an indictable offence.[1] An accomplice is regarded in the same light, and in some of the States and in England the *attempt* is deemed to be a misdemeanor.

A criminal simulation of a graver character is cited of an assassin who tried to impart the belief that he had committed murder to escape a pederastic assault.

Acts of this nature are not always the necessary consequence of insanity. Sexual crimes of the most shameful and revolting character, such as profanation and mutilation of the dead, have been committed by individuals held to be sane. Legrand du Saulle[2] mentions a series of cases of this almost inconceivable monstrosity, and shares the belief of Morel that there is in reality no act so depraved, committed by the insane, not even excepting the violation of cadavers, that has not been accomplished by individuals in full enjoyment of their reason (see Necrophilia, p. 487).

But in making an expert survey to determine the criminal responsibility, or it may be the civil capacity,[3] of an individual accused of sexual crime, conclusions should not be based upon the nature of the libidinous acts alone. The examination should be conducted upon the lines best adapted to show whether the accused has yielded to an unhealthy and irresistible incitement, or to the suggestion of his passion.

For additional information on this subject see case of Julius Krueg, *Brain*, 1881; case of Alder Blumer, *Am. Jour. of Insanity*, 1882; case of Wise, *Alienist and Neurologist*, 1883; Savage, *Jour. of Mental Science*, 1884; Wacholz, Dr. Leo, *Friedreich's Blätter für gerichtliche Medicin und Sanitätspolizei*, Nürnberg, 1892, XLIII., 431; *Maryland Medical*

---

[1] 2 Chit. L., 50.

[2] "Traité de Méd. Lég.," Paris, 1886, pp. 397–402.

[3] President Cleveland has lately (June 23d, 1894) declined to restore to citizenship W. W. Knott, of Chicago, who served a term at Joliet for sending lewd circulars through the mail. The President's indorsement is: "Denied—Before I return to this convict his rights of citizenship I must be abundantly satisfied that he is living a decent life, and engaged in a decent occupation." Knott wrote a dirty novel called "Stolen Sweets," and the circulars which he sent out about it were worse than the book itself.

Journal, 1893, XXIX., 199; Chevalier, J., "Une Maladie de la Personnalité," Lyon et Paris, 1893; *Annales d'Hygiène*, 1893, 3 S. XXIX., 457; "Epilog zum Prager Prozesse Waldstein," *Wiener medizinische Wochenschrift*, 1893, XLIII., 147; Krafft-Ebing, R., "Der Conträrsexuale vor dem Strafrichter," 1894.

RAILWAY INJURIES:

THEIR

CLINICAL AND MEDICO-LEGAL FEATURES.

BY

W. B. OUTTEN, M.D.,

Dean and Professor of the Principles and Practice of Surgery in the Beaumont Hospital
Medical College; Chief Surgeon of the Missouri Pacific Railway; Late
President of the National Association of Railway Surgeons;
President of the St. Louis Medical Society;

Consulting Surgeon St. Louis City Hospital and Female Hospital; Consulting Surgeon
St. Luke's Hospital; Consulting Surgeon St. Louis Baptist Sanitarium; Consulting
Surgeon St. Louis Baptist Hospital; Consulting Surgeon Mt.
St. Rosa's Hospital; Member Medical Association, Member
State Medical Association of Missouri, Member
St. Louis Medical Society, Missouri,
etc., etc.

RAILWAY INJURIES, THEIR CLINICAL AND MEDICO-LEGAL FEATURES.

INTRODUCTORY.

Railways have in their construction, organization, and manipulation created more sociological problems than any single source in modern civilization. In accord with this assertion it can be stated with truth that railway injuries in consequence of mistaken views, imperfect elucidation of thought, their broadly advertised uncertainty of result, financial elements, have created sociological problems far-reaching and positively deleterious to the moral conduct not only of the single individual but of communities as well.

The unmeasured and intemperate bestowal of damages for real and imaginary ills has so influenced all classes of people that, where the railway is concerned, moral obliquity is apparent from the contact. When injuries occurring upon the railway are considered in either compromise or litigation, truth and honesty have been thrust aside, a travesty made of equity and right, and in almost every instance the conscience of the injured individual and his advisors justifies the most dishonorable means if the monetary end is obtained.

Experience shows that not only the working classes, but all grades of the social body, may, and do at times, become speculative and grasping. This condition, then, must of necessity evolve problems both ominous and threatening. Formerly both legal and medical professions were influenced in directions which were not worthy of the integrity and nobility of these respective callings. No subject in modern medicine has thrown more discredit and contumely upon the medical expert than the consideration of the immediate and ultimate effect of certain railway injuries.

This the writer conceives has resulted from the fact that in the attempt at classification and nomenclature of functional diseases arising from railway and other injuries, confusion and lack of knowledge has so hidden the true state and results of railway injuries as to make them obscure in the extreme. This lack of knowledge and obscurity naturally created a mass of theoretical ideas unfounded on fact. Hence, even an honest endeavor, at times, would be construed into meaning duplicity and dishonesty. When we take into consideration how freely it has been asserted that the medical expert testimony is of little value, because the medical expert seemingly becomes too easily a prejudiced partisan, readily losing his individuality and adopting the views of the counsel without regard to truth or common sense. It now becomes necessary that the expert should be considered broadly and unprejudiced.

The writer, from extended experience, not in large centres alone, but in States and communities, can testify to the fact that his observations show that in a great majority of instances he has observed that honesty and truth have been accorded their proper modicum of respect. As a general thing he has seen, not only on the part of the court, trial lawyer, jury, but medical expert as well, wherein an honest endeavor was made to determine the facts, and that there was a constant tendency to maintain justice as comprehended in and under honesty, integrity, and impartiality.

A review of cases submitted to litigation, and the personal experience of witnesses and observers and attendants upon court, often indicate that at times, possibly too frequently, pernicious elements prevail. While it may hold true in certain communities or localities that falsehood and duplicity, pernicious partisanship, malevolent twisting of facts and evidence, have been enacted more or less constantly, to the exclusion of high-minded equity and right, yet this is very far from being generally prevalent. Again, there is a tendency upon the part of many lawyers and captious critics to assert that all the fault of this dishonesty and injustice lies with our present jury system. The writer believes that any close, unbiassed, and unprejudiced observer cannot fail to recognize and acknowledge that there is in all intelligent juries an invariable tendency and an honest endeavor upon their part to decide according to truth, evidence, and justice. Hence, in litigation arising from certain railway injuries where hidden, unsettled, and obscure points constantly cloud the field of decision and consideration, there must and will arise seemingly unjust and irrelevant conclusion. But when these questions can be cleared of their hidden and confusing elements, and the truth made apparent, it will be found that courts and juries will sustain the high and noble standard of right and justice.

It is the bounden duty of corporations and others to create not only the impression, but the absolute fact, that truth and justice govern their actions in dealing with these cases. Just in proportion as the attempt is made to subvert truth and fact by either corporations or individuals, just in proportion will prejudice prevent and results run into the realm of exaggeration and injustice. The power to change truth into lie does not exist in the capacity of man, corporation, or nation. It is eternal and will prevail; and the sooner this is recognized the less will be the occasion and opportunity for the infliction of prejudice and injustice.

Again, wherever possible, honorable, just compromise should be obtained. It is the duty of the counsel, and doubly the duty of the medical advisor, to strive to reach this honorable purpose, since the incident worry of litigation and attending evils have been demonstrated as pathologizing in the extreme, tending to stamp an incurable chronic condition upon the inflicted person. It is now an incontrovertible fact that all fair-minded neurologists and cultured medical men acknowledge the powerful and alleviating influence of compromise as a true and correct therapeutic agent in railway injuries followed by ulterior effects. Hence it will be found that the sensible and just medical attendant does not hesitate at any time to advise compromise. We conceive that the intelligent and true lawyer will view this subject upon the same high standard, since the field of compromise is one where honorable professional men rarely disagree, where dignity is maintained and a truthful manly standard. Compromise will permit a much nearer approach to strict justice than a court, which necessarily permits the conflict of truth and falsehood, frequently to the exclusion of justice. Compromise generally, to all concerned, is the purest and best form of economy to the plaintiff; it takes away the worry of delay and irritating circumstances. For the corporation it saves money and reputation.

The past ten years have shown a complete change in the views concerning certain railway injuries. The history of these injuries shows that from 1866 up to within ten years ago the railway was singled out as the only source producing diseases of a strangely peculiar character, induced by physical injury and mental shock. Railway spine was accentuated by different writers under different names, and no effort was seemingly made to show that the group of symptoms under this head could occur anywhere else than on the railway.

The writer believes that it has now become necessary in the consideration of railway injuries that they should be considered generally, and not viewed as heretofore. Their consideration has been done in a desultory and unconnected manner; no attempt was made to correctly classify and name their causative factors. Unless a careful study is made of the acting forces, the character of the inflicting agent, the manner of infliction, circumstances and surroundings attending the injury, the student cannot form a just idea of their immediate and ultimate effects.

An endeavor has been made by the writer to classify railway injuries according to their causative factors, starting out with the assertion that all railway injuries are the result of force or energy in motion. The kinetic energy, or energy in motion, its disruption or derangement, produces the various railway injuries inflicted upon man. His classification is based upon the kinesic condition of the individual at time of injury, and not upon the kinesic condition of the mechanical or inflicting agent.

A study has been made regarding the manner of injury occurring to passengers, citizens, trespassers, along with injuries to employees. The number of railway injuries thus tabulated were 82,361.

The writer has been fortunately placed in a position where he could make a special study of the psychic conditions arising in persons affected by railway accidents, such as collisions, derailments, etc. His examinations have been made at a number of wrecks, in one of which he was personally concerned, and in another he was upon the scene within a half an hour after the occurrence. In the greater number there was an interval from two to five hours intervening. His experience compels him to believe that in the healthy, young, vigorous, and contented person there is no essential difference in the psychic manifestation and ultimate results, whether the person be a passenger or employee. All classes of persons thus injured by the railway are subject to psychic shock, and invariably manifest it immediately after the accident. He contends that it is human and natural to be thus affected, and that it would be unnatural not to be. Investigation will show that the suddenness of occurrence, the horror of circumstance, are as potent in engendering psychic shock upon the employee as upon the passenger. Subsequent reaction in both is the same if youth, health, vigor, and contentment are existing in the shocked person. Reaction from psychic shock is almost the invariable rule with the young and healthy. Its effects are not the result of vocation nor familiarity with attending surroundings, but a matter of resistance arising from physical and mental health. It has never been determined what influence suggestion has upon man individually, hence the subsequent surroundings and circumstance upon the affected person become an unknown but an undoubted powerful factor in the formation of ulterior consequences arising from railway injuries.

The investigator cannot fail to be appalled in reading the various estimates given by different statisticians concerning the number of personal injuries occurring in the United States, arising in and incidental to different industrial pursuits. It is to be deplored that the statistics compiled by the Interstate Commerce Commission are justly criticised for their imperfect showing. Notwithstanding this fault, they give a basis from which important conclusions can be formed. The following show the number of injuries occurring upon railways for the year 1904:

	KILLED.	INJURED.
Interstate roads	9,984	78,247
State roads	[1] 975	7,500
Trolley lines	[1] 340	52,169
Total	12,299	137,916

[1] Estimated.

We quote from W. J. Ghent, *Watson's Magazine*, which says: "When we pass from the record of particular industries to the general casualty record, we are met by a mass of unintelligible figures. But Bulletin No. 83 gives the rate of fatal accidents in the cities, where registration is required, as 100.3 in each 100,-

000 population. For the whole registration record, as 96.3. On a basis of 80,000,000 population this would mean a yearly loss of from 77,040 to 80,240 lives. Mr. Frederick L. Hoffman, of the Prudential Insurance Company, in a letter printed in Robert Hunter's recent volume, 'Poverty,' estimates the rate as between 80,000 and 85,000. This would mean from 64,000 to 68,000 killings. If we say that 25 are injured to every one killed, and consider the fatal-accident rate to be 80 in every 100,000, we have it that 1,664,000 were killed annually or are more or less seriously injured in the United States. If all minor accidents were taken into consideration it is probable that a ratio of non-fatal accidents to fatal accidents would be nearly 100 to 1. This would mean approximately 4,800,000 minor wounds every year."

Notwithstanding the immense number of personal injuries occurring in this country, very little systematic work upon the part of the medical profession has been done in the study and interpretation of special cause. In this article now being written an endeavor will be made to systematically study and interpret special causes in railway injuries. Any one who has not had constant study and experience in the interpretation of special causes existing in railway injuries would be inclined to attribute too much influence to defective mechanical appliances, defective construction, and to many erratic physical conditions arising in the operation of the railway. There is nothing in or connected with man more amazing or confusing than his multiform mental states. There is no element about him, as a general thing, so little noticed when engaged in his selected vocation. The weightiest causes of accident are the most silent, insidious, and least comprehended. In a vocation like the railway employee's, where the handling of blindly obedient and enormous mechanical power is common, hence it becomes replete with repetition and seemingly unconcerned familiarity. It becomes evident to a student of special cause that as repetition and familiarity accrue in his [the employee's] pursuit, the more does the employee beget a propensity to grow into transient states of absent-mindedness, immediate phases of unconscious moods, wherein duty and dangerous surroundings are for the moment forgotten. A detailed account of many catastrophes properly investigated, and from confidential interchange of opinion with employees in these catastrophes, have shown the writer that absent-mindedness and other mental aberrant conditions are constant and fruitful causes of these troubles.

Considering the immense number of personal injuries and fatalities, the writer believes that it is the paramount duty of any one attending to these injuries to endeavor to bring to notice any point or points which aim to create a closer study of special cause, with the hope that some protecting measure may be formed having in view a lessening of accidents and consequent injury and death.

The writer believes that if a close study is to be made regarding the employee's physical condition, so as to determine if there be any element or elements in the nature of his vocation tending to beget these mental states, it should be especially considered whether at any time overwork is too often indulged in, or whether an employee's habits tend to create a physical condition which leads to a lack of proper mental tone. *In terse*, study every element concerning the vocation, aiming to guard against the many physical conditions which are prone to lead to laxity or disturbance of normal mental health.

After thirty years' labor as a railway surgeon the writer is compelled to believe that no matter how many safety mechanical appliances are invented and used, no matter how rigid the discipline may be, no matter how close inspection and consideration of elements used in construction may be, catastrophes must and will occur unless some means can be applied to correct the employee's mental aberrant condition. A close consideration of special cause leading to railway accidents establishes the truth that from 15 to 20 per cent of accidents are due to what executives call "negligence," and from 17 to 20 per cent were unexplained.

It is to be understood that this 32 to 40 per cent includes the most serious and destructive accidents occurring upon the railway. Again, of this 32 to 40 per cent, mental aberration in our opinion is the most powerful and constantly acting causative factor. The real worth of various mechanical safety appliances is hard to determine, since they are as frequently overrated as underrated. While a combination of disciplined intelligence, and perfection of mechanical detail must be at all times a powerful barrier to the occurrence of accidents, still just so long as railways and other industrial pursuits permit overwork, and are unmindful of the true physical and mental condition of the employee, just so long will the worst form of catastrophe occur.

If the writer can direct or cause more thought and study to be given to conditions or causes leading to transient mental aberration occurring to employees in various industrial pursuits, he will consider that he has done something commendable. If numbers and gravity in extent of personal injuries are worthy of consideration, certain it is that no subject in medicine calls for more earnest and constant endeavor than that which looks to a lessening of personal injuries in general in railways and other industrial pursuits.

No element in all operative causes in the production of personal injuries is as important as the study and interpretation of conditions which may or are likely to lead to transient mental aberrations, having for their basis such states called absent-mindedness, transient unconsciousness of immediate surroundings. It is equally as important to study the conditions which lead to wandering and unfixed attention, since this leads to a loss of a sense of duty necessary in the normal operation of pursuits where mechanical power must be used and which should be properly guided and governed.

CHAPTER I.

CAUSATIVE FACTORS PRODUCING RAILWAY INJURIES.

1st. Classification of causes—Laws of liability.—2d. Mental condition of employees always an uncertain but positive causative factor in the production of accidents and catastrophes.—3d. Illustration of heterophemy and auto-hypnosis occurring to employees.—4th. Causal factors of the catastrophe.—5th. Conditions necessary to the safe operation of the railway.—6th. Road-bed as a cause in producing accidents.—7th. Curves of the railway as a cause in producing accidents.—8th. Elements diminishing the danger of curves.—9. Dangers of the gradient as a cause of accidents modifying causes.—10th. Switches as a cause of accident—Virtues of split switch and stub switch.—11th. The bridge as an agent in the production of catastrophe.—12th. The small trestle or bridge more fruitful of acccidents than the larger structures.—13th. Bridge accidents commented upon.—14th. Manipulation of trains as a cause of accident.—15th. Negligence of employees, and disease and overwork as causes.—16th. The rules of train-despatching, if rigidly followed, provocative of accidents.—17th. The semaphore and the interlocking switch considered.—18th. Causes due to defective motive power.—19th. Inspection of trains, Miller platform, Westinghouse brake.—20th. Natural phenomena as a cause of accident.—21st. Classification of the causes of railway accidents explaining the kinetic-kinesic accident, the bi-kinesic, the mono-kinesic, and the un-kinesic.—22d. The difference between citizen and trespasser.—23d. Remarks as to manner of injury occurring to citizens and trespassers.—24th. Manner of injuries occcurring to passengers.—25th. The character of vocation among railway employees to whom injuries must frequently occur, along with manner of injury.—26th. Why railway wrecks, under present conditions, will be of frequent occurrence.—27th. Conclusions.

Classification of Causes—Laws of Liability.

Railway accidents may be classed under two general heads: 1. "Catastrophes," where numbers of individuals are injured at the same time. 2. Individual accidents where the individual alone suffers. These causes may be divided into two general classes: 1. Defects in the normal operation of the railway such as defects in road-bed and accessories, defects in rolling power and motive stock, defective construction, mental aberration, and negligence. 2. Acts of Providence where natural phenomena operate with such suddenness as to debar the possibility of human anticipation, warning, or protection, such as waterspouts, etc., acts of individual malice. Individual acts arise essentially from the same causes, in many cases, as catastrophes, but generally have for their basis imprudence, negligence, mental conditions or physical defects of the individual. Where the element of negligence in the administration of the railroad obtains, liability for injuries is accepted by the railway corporation, both for catastrophes and for injury to the individual. It is, and has been since 1846, a thoroughly established principle of law that when negligence exists, corporations[1] "are liable for past and future physical and mental suffering, together with the loss of earning power where the consequences are such as in the ordinary course of nature may be reasonably expected to ensue." The duty of a railway company to its employees has thus been defined: It is bound "to use all reasonable care and foresight, to provide safe structures, competent employees, approved appliances necessary to the safety of the employee, and to adopt and enforce such rules and regulations for running its trains as will avoid injury to its employees so far as this can be reasonably done." A railway company is legally bound to use reasonable care and judgment in the selection of ordinarily skilful and trustworthy servants, and is liable for the wrongful acts of its servants done while acting within the scope of their duties, although such acts were not only not authorized but positively forbidden. The company which, with a knowledge of the wantonly wrong conduct of its servant, maintains him in its employ, thereby ratifies his actions. An employee whose acts are such as to justify an award of punitive damages is guilty of conduct which calls for his dismissal from the service. The rule which requires the reasonable exercise of care in the selection of competent servants applies with equal force to their retention. Wanton recklessness may be established by showing gross want of care, skill, and judgment in furnishing suitable machinery, materials, and appliances, as well as in the selection of servants. Taking into consideration the enormous responsibility imposed upon railroads in the handling of trains, and the transportation of millions of people annually, it can be safely said that every endeavor upon their part is in the direction of safety, with the aim to render accidents infrequent by the most complete investigation and inspection, and their maintenance in proper condition of all materials used; by perfecting the physical condition of road-bed and accessories pertaining thereto; by care of motive power and rolling-stock; and by employing disciplined agents in the manipulation of its trains. But with almost perfect inspection, analysis, and study of materials used, erratic and unforeseen conditions may be engendered and become manifest in accidents.

---

[1] Patterson on Railway Law.

MENTAL CONDITION OF EMPLOYEE—ALWAYS AN UNCERTAIN BUT POSITIVE CAUSATIVE FACTOR IN THE PRODUCTION OF ACCIDENTS AND CATASTROPHES.

For the selection of employees imperfect data only are attainable; hidden and oftentimes masked mental states cannot be discovered or made manifest by any means at man's command; it cannot be foretold at what moment a man's brain may act abnormally and cause a catastrophe. In general, aberrant mental conditions are of such nature that their occurrence cannot be foreseen and prevented. The gradual origin of pathological conditions incidental to the nature of employment, morbid conditions otherwise acquired, and the evolution of hereditary defects, are all operative in the possible production of anomalous mental states; hence it is utterly impossible to form a just judgment of mental conditions in all individuals at all times. Therefore, so long as human agents are necessary in the manipulation of railways, so long will the catastrophe be an attendant upon their management; and that too, in spite of the best discipline, and of the most perfect study and inspection of every factor entering into their equipment and manipulation.

ILLUSTRATIONS OF HETEROPHEMY AND AUTO-HYPNOSIS OCCURRING TO EMPLOYEES.

Thus, in illustration, take that mental condition which occurs among railway train-despatchers and has caused many fatal accidents, called by Richard Grant White "Heterophemy," or thinking one thing while saying, hearing, or reading another.[1] This condition is not peculiar to the train-despatcher, but is found among almost all other classes of employees. The work of the train-despatcher, however, renders him especially obnoxious to it. Again, an "auto-hypnotic" condition is common among engineers, engendered in them in consequence of habits arising from the nature of their work. Familiarity with the road leads to concentration of gaze upon some particular part of engine or road, until a state resembling hypnosis is produced, in which unconscious cerebration is made manifest.[2]

CERTAIN MENTAL STATES LEADING TO CATASTROPHE.

Again, careful investigation will disclose the fact that aberrant mentality among railway employees is the most prolific cause of accident, particularly that condition commonly called absent-mindedness or states and moods akin to immediate unconsciousness of surroundings and wandering attention. Proneness to these absent-minded states is in the great majority of instances seemingly dependent upon certain conditions engendered by the too long continued performance of a given duty. An engineer who has been on a regular run for years becomes familiar by daily contact and practice with every element appertaining to that run. This unceasing performance of a given duty, the never-ending repetition of the same, becomes so deep-rooted that machine-like habit is evolved which sooner or later tends to automatism, thus begetting thoughtless and mechanical action. The more automatic man becomes the less do normal surroundings and stimuli affect him (even when on an engine), he loses the sense of running, and the sheer monotony developed by too great repetition tends to make him seek other fields of thought than duty, hence absent-mindedness becomes unduly frequent. An engineer or others handling powerful and concentrated mechanical motors, prone to absent-minded states, will inevitably be the cause of injury and catastrophe. Could the true cause of accidents be at all times determined it would be found that no particular cause of accidents is more fruitful of injury and death than those mental states classed under the head of absent-mindedness wherein aimless and disjointed thought and attention become active. The more we investigate lax, unfixed, and wandering mental states under the conditions surrounding many positions upon the railway, the greater they appear as causes of accidents. All conditions of mentality based upon inattention, forgetfulness, unconsciousness of immediate surroundings as in the absent-minded or other mental moods are dangerous particularly in the transportation department of the railway. Any mental condition tending to sudden and ill-considered mental action can create accident and catastrophe; nothing known is so quick and sudden as mental action, and nothing more dangerous when unbacked by thought, discretion, and judgment; consequently when we closely consider the many physical and mental conditions which may influence and lead to aberrant mentality the wonder comes that more accidents do not occur than are made manifest.

---

[1] E. Alexander on "Railway Management," in Scribner's "American Railway," 1893, says: "A case within my knowledge which cost a dozen lives was as follows: Two opposing trains were out of time, and the train-despatcher wished to have them meet and pass at a certain station we will call I., as No. 1 and No. 2. So he telegraphed the following message to be delivered to No. 1 at H. and No. 2 at J.: 'No. 1 and No. 2 will meet at I.' This message was correctly received at J. and delivered to No. 2, but at H. the operator had just sold a ticket to a passenger to K., and, getting this name in his head, he wrote out the message: 'Nos. 1 and 2 will meet at K.' But the mistake was not yet past correction. The operator had to repeat the message to the despatcher that the latter might be sure that it was correctly understood. He repeated it as he had written it, 'K.'; but the despatcher was also 'heterophemous.' He said 'K.' but thought 'I.,' and replied to the operator that the message was O. K.; so it was delivered to No. 1, and that train left H. at full speed to make thirty-five miles to K. before meeting No. 2. There was no telegraph office at I. and there were no passengers to get off or on, and it passed there without stopping, and three miles below ran into No. 2 on a curve. By one of those strange impulses which seem to come from somewhat unconscious cerebration, the train-despatcher meanwhile had a feeling that something was wrong, and looked again at the message received from H. and discovered his mistake. But they were then out of reach; and he still hoped that No. 2 might arrive at I. first, or that they might meet upon a straight portion of the road; and as the time passed he waited at the instrument in a state of suspense which may be imagined. When the news came he left the office and never returned."

[2] Upon investigation I have found these conditions to exist: owing to the fact that an engineer is familiar with his road, knows certain stretches of track, and is habituated to the running of his engine, he gazes constantly on some portion of engine or track. It is the concentration of vision on limited area which is used by the neurologist to produce hypnosis. It is the concentration of vision with the engineer which begets similar conditions. Time and time again have I heard engineers' firemen detail stories plainly indicating unconscious cerebration in their superiors. Stories of erratic action during the time of accidents often point to the existence of this condition.

Causal Factors of the Catastrophe.

In the production of a catastrophe it can rarely be said that but one factor has been operative; for, as a general thing, the disaster must be attributed to the combination of a variety of anomalous conditions, such as defective materials, defective mentality in employees, and dangerous physical surroundings. Thus, in illustration, take the Ashtabula catastrophe, which occurred at Ashtabula, Ohio, on the Lake Shore and Michigan Southern Railway, on the 29th of December, 1876. The contributing conditions were a bridge of faulty construction in the first place, built over a deep ravine—sixty-nine feet above bottom of ravine—in which indications of weakness had been presented, but of which no notice had been taken; heavy snowdrifts; two locomotives attached to a train of eleven cars, one of which partly passed over, the other and nine coaches went to the bottom of the ravine; cars heated by stoves took fire; and contradictory orders were issued, to subdue the flames, in consequence of which the cars were consumed. More than half of the passengers were otherwise killed or allowed to be consumed by fire. Eighty persons were killed, and sixty others injured, costing the railroad company over six hundred thousand dollars.

Conditions Necessary to the Safe Operation of the Railway.

It has been asserted with truth that nearly everything used on a railway has an economic or mechanical value, and that if it promotes safety it is but a part of its duty. "A great source of safety in railroad working is good discipline. Of all the train accidents which have happened in the United States in the last sixteen years nearly ten per cent were due to negligence in operation, and seventeen per cent were unexplained. Of these no doubt many were due to negligence, and many were attributed to defects of track and equipment which would have been prevented had men done their duty. The value of mechanical appliances for. safety perhaps is as often over-rated as under-rated; undoubtedly the best, and in the long run the cheapest, practice will be that which combines in the highest degree both elements —disciplined intelligence, and perfection of mechanical detail."[1]

[1] H. G. Prout "Safety in Railroad Travel," in "The American Railway."

At this juncture it will be fit and proper to individualize the essential elements constituting the railroad, and their causative power in producing accidents.

Road-Bed as a Cause in Producing Accident.

The road-bed, of course, constitutes the chief element of the railroad, and we find its various modes of construction depending entirely upon the physical condition of the surface on which it is to be placed. All railway lines in the older countries were made as straight as possible, with easy grades and gentle curves; but in this country different conditions arose and were met; physical difficulties formed no barrier, and in proportion as difficulties were encountered, ingenuity seemed to be stimulated and always ready and competent to overcome them. First, as to ballast, which is the means of preserving the integrity of the superincumbent track placed upon it, and as a general thing constitutes the chief factor of the railroad's safety. The ballast used depends upon the soil of the country where the road is constructed; in certain States, particularly in some Southern States, sand ballast seems competent to make a safe and elastic road-bed. As a general thing, broken stone, macadam, slag, cinders, or gravel, forms the road-bed. Accidents may and do arise from this source, as from neglect to prevent a gradual impaction of ballast due to heavy weights above, which causes *swinging joints* and breakage of rail; or from freezing and subsequent thawing of the ballast with consequent softening of the earth beneath; or from excessive rain washing portions out, at times causing the track to sink, with interruption of its continuity. Cross-ties are now used upon most of the railways of America, and they are generally made of hard wood, though in certain portions of the country softer woods answer—white oak, chestnut, locust, catalpa, and yellow pine. The base of the rail rests upon these cross-ties, and the number essential to constitute a good solid road-bed varies, depending upon their width and the physical condition of the soil, from 2,000 to 3,500 per mile. Thus, if ties are laid with a separation of 18 inches from centre to centre, there will be 3,520 ties to the mile; with 30 inches from centre to centre, 2,113 to the mile. The integrity of the tie, of course, keeps the rail from spreading, as each rail is spiked on to the tie. Under certain conditions where age produces decay or fire burns the wood, the tracks spread and cause derailment of the train. Bessemer steel rails are now used upon all main tracks where speed is demanded and excessive weight carried. By actual test one steel rail has outworn seventeen iron rails, with only five-sixteenths of an inch worn off at its top. The average weight of the steel rails now used ranges from sixty to eighty-five pounds per yard. Under certain exceptional circumstances a rail weighing as high as one hundred and twenty pounds per yard is used. Their average length is thirty feet. The weight which rails will carry without being injured depends somewhat upon their size and weight, but ordinarily from twelve to sixteen thousand pounds per wheel is about the greatest load which they should carry. Where rails are joined together, two iron or steel bars from eighteen to twenty-four inches long, called fish-plates, are bolted on both sides of the union. There are 352 complete joints per mile. Where the joint lies immediately above a cross-tie, it is called a "supported joint"; when the cross-ties come on each side of the joint, it is called a "suspended joint," and the latter is considered the best, as greater elasticity is imparted to the track, and there is less injury to the ends of the rails, thus preserving the virtues of the joints in a greater degree. The integrity of joints at times becomes involved, thus causing accident. The rail itself, of course, depends for its integrity upon a solid road-bed, which, as we have already indicated, in turn depends upon the solidity of the earth on which the ballast is placed, upon the strength of the ties, and upon the strength of the joints. Other conditions aside from these frequently involve the track (the rail). Extremes of temperature causing expansion and contraction of rail have been a cause of its fracture. Broken rails are very frequently the cause of derailment of trains, and oftentimes, where conditions are unfavorable, lead to a catastrophe. Thus upon the Erie Railway, April 14th, 1876, a train made up of a locomotive, three baggage cars, and seven passenger cars, encountered a broken rail at Carr's Rock while rounding the curve and going at a high rate of speed. The outer side of the curve was a steep declivity of some eighty feet, "jagged with rocks and boulders."[1] The broken rail was safely passed over by all the cars except the last one, which was thrown off the track, and then dragged along for a short distance. The great strain then broke the coupling between the four rear cars and the head of the train. The last of the four being already over the embankment, the others were instantly toppled over after it, and rolled down the ravine. Twenty-four persons were killed and eighty injured. From no source do we have as many derailments as from broken rails, and that, too, in spite of studious care and previous investigation and close watching of the rail. The integrity of a rail cannot, as a general thing, be determined from its appearance. Age and use wear out even steel.

---

[1] Adams on "Railway Accidents." G. P. Putnam's Son, New York, 1879.

Curves of the Railway as a Cause of Accident.

In the growth of the railway in this country, former precedent had to be ignored; the establishment of curves became an economic factor in their construction. While a tangent is always desirable, yet curves enabled impediments to be overcome and miles of road to be built which otherwise could not have been constructed. While curves on the railway are oftentimes points of essential danger and the cause of accident, owing to the fact that as a rule they occasion obscuration of vision which at times is conducive to collisions, not only with trains, but with land-slides and other impediments thrown on the track, they are likewise dangerous in consequence of the play of contrifugal force.

Elements Diminishing the Danger of Curves.

The swivelling truck placed above the front wheels of our locomotives and under cars overcomes many of the dangerous elements of curves; likewise the equalizing beams or levers by which the weight of the engine is always borne by three or more driving wheels. The latter "act like a three-legged stool, which can always be set level on any irregular spot." Centrifugal force ceased to be the great element of danger when these improvements were devised, engines and cars passing around curves with impunity in consequence of the improvements indicated. There are on our main lines in this country curves with a radius of less than three hundred feet, while upon

European railways there are but few curves having a radius of less than one thousand feet. On the Manhattan Elevated Railway, with the largest passenger traffic in the world, the road is conducted around curves with a radius of less than one hundred feet. Curves under certain conditions must necessarily always be dangerous, particularly owing to the liability to derailments on them arising from broken equipment, such as broken tires and flanges on engines, broken flanges on car wheels, and broken rails.

DANGERS OF THE GRADIENT AS A CAUSE OF ACCIDENT—MODIFYING CAUSES.

The gradient of a railroad constitutes one of its economic factors. Steep grades curtail its earning capacity, and in earlier days they were a constant source of danger, especially over mountain roads, owing particularly to the liability to disruption of couplings and the incapacity of brakes, with consequent collisions and derailments. The discovery of the climbing capabilities of locomotives on smooth rails,[1] and the great improvement in brakes, particularly in the Westinghouse, with its continuous element, triple valve, and automatic arrangement, affording reliable means of stopping trains upon steep grades, overcame one element of danger. Again, the switchback, with its zig-zag arrangement for reducing grades, by means of which trains are made to go up and down in safety where otherwise the grade would be a constant menace to the passengers and the employees of the railway, has done its share in removing danger. In proportion to the natural danger of surroundings extra care is exercised, and it is rare indeed to have a serious accident in the present day from steep grades. Grades vary according to the region or physical phase of nature to be met. Upon the main line of our railroads they vary from five feet per mile to two hundred and eleven feet per mile. Thus trains go over four-per-cent. gradients in Colorado.

It has been computed that thirteen per cent. of the train accidents in the United States in the last sixteen years were derailments due to defects of road. Good material, good workmanship, and unceasing care are absolutely necessary for the proper working of a railroad.

---

[1] B. H. Latrobe, chief engineer, Baltimore & Ohio Railway, discovered this in 1852.

SWITCHES AS A CAUSE OF ACCIDENT—VIRTUES OF SPLIT-SWITCH AND STUB-SWITCH.

Another element productive of accidents has been the switches. Although the number of accidents caused by switches has not been very great, still their effects at times have been serious and undoubted. H. G. Prout, speaking concerning the accidents from derailment, says: "These include not only defective rails, switches, and frogs, but bridge wrecks. There are, however, few devices used in the tracks that can be called safety appliances. Many so-called safety switches and safety frogs are offered to railway officials, but those actually in wide use comprise but a very few standard forms. The split-switch has gradually replaced the old stub-switch, as well as the so-called safety switches that have been from time to time introduced, although the stub-switch is in considerable use in yards where movements are slow, and on the main tracks of the less progressive roads. It consists of a pair of moving rails the end of which may be placed opposite to the ends of the main line or to those of the turn-out, as the needs may require. It follows that but one of these tracks is continuous at any one time, and the train reaching the switch by the other track must be derailed. The distressing accident which happened at Rio, Wis., in 1866, when seventeen people lost their lives, was a derailment of this sort. Since that time the railroad on which it happened has taken out stub-switches on thousands of miles of main-line track. The split-switch provides against such derailments, for if the switch is set for the turn-out and a train approaches it from the main line in the 'trailing direction' the flanges of the wheel move the switch-rail to make the track continuous. The terms 'facing' and 'trailing' as applied to switches are almost self-explanatory—if a train approaches toward the points of the moving rails the switch is said to be 'facing'; if it runs to the switch from the rear of the moving rails, the switch is said to be 'trailing.'"

The Bridge as an Agent in the Production of Catastrophe.

Probably no factor as a cause of accident on railroads has been more immediately destructive of human life, attended with the most harrowing details, than the railroad bridge. While, in the aggregate, collisions cause one-third of the train accidents, and derailments more than one-half, and these are constantly more destructive to life and property, yet the bridge accident to passenger trains rarely fails to partake of the nature of a catastrophe, owing to the intensity of the forces at work —gravity which plays a profound part, and physical nature, which the bridge in its integrity conquers. It has been estimated that there are now in the United States nearly 220,000 bridges of all kinds.[1] Competent authorities claim that the wooden bridge and trestles enabled this country to build 150,000 miles of railway; and that America adopted the invention of Leonardo da Vinci, and made practical the ideas of the seventh century in the more progressive nineteenth century. The first wooden truss bridge was a product of American invention, and, as claimed by Clarke, Burr and Wernburg, two Pennsylvania carpenters, were its originators. A bridge built by Wernburg across the Delaware River in 1803 was used as highway bridge for forty-five years; it was then strengthened and used as a railway bridge for twenty-seven more, when a new structure replaced it. C. Whipple, civil engineer, made the first attempt to solve the mathematical problem upon which the due proportion of the iron bridge depends. The Howe truss bridge is constantly used on Western roads, to be ultimately replaced by iron or steel. The introduction of mild steel in bridge-building made greater advances and more perfect construction possible. It is claimed that steel has an ultimate strength of from sixty-three to sixty-five thousand pounds per square inch, or forty per cent more than iron. And it is tough enough to be tied in a knot or punched into the shape of a bowl while cold. With this material it is as easy to construct spans of five hundred feet as it was to build spans of two hundred and fifty feet in iron. Bridges are now designed to carry much heavier loads than formerly. The best practice adopts riveted connections, where pins and eyes are still very properly used. Plate girders below the track are preferred up to a length of sixty or seventy-five feet, then riveted lattice up to one hundred and twenty-five feet. It is hardly necessary for us to enter into detail regarding the various improvements in bridge construction. The wonders, strength, and effectiveness of the cantilever bridge have been demonstrated beyond question. The successful erection of the Niagara Suspension Bridge by John A. Roebling, at that time the wonder of mechanical ingenuity, which, with its almost cobweb-like appearance, was capable of bearing many tons with perfect safety, with a span of 821 feet, and the railroad track 245 feet above the water surface, made it a marked and constantly admired success. This bridge successfully carried a heavy traffic for nearly fifty years, and has recently been replaced by a steel arch. The larger bridge structures have been projected with a view to strength and safety, the adjustment of every part has been made with mathematical precision, and they have always been constructed with especial reference to their future duty, their permanency and stability constituting the reputation of their constructor.[1] It is a notable fact that no modern steel structure has yet proven its ineffectiveness. Where immense sums of money are expended in bridge construction it is safe to say that nothing is done hurriedly; that adequate and intelligent caution debars the possibility of faulty construction, and that in consequence an accident rarely occurs.

---

[1] Iron and wood truss bridges in the year 1888 numbered 61,562 feet span, 1,086 miles; wooden trestles 147,187 feet span, 2,127 miles; total, 208,749 feet span, 32,013 miles.

Probably three-fourths of the truss bridges are now of iron or steel and we can feel perfectly safe so long as the train remains upon the rail and does not strike the side of the trestle.

Wooden trestles are a constant source of danger, producing injuries from derailed train, and should be replaced by permanent structures when time and money will allow. —Thos. Curtis Clark, in the "American Railway."

---

[1] An excellent example of an American truss bridge is the structure which spans the Missouri River at its crossing by the Northern Pacific Railway. It has three through spans of 400 feet each, and two deck spans of 113 feet each. The bottom chords of the long span are 50 feet above high water, which at this time is 1,636 feet above the level of the sea. The foundations of the masonry were laid by means of pneumatic caissons. The trusses of the through spans, 400 feet long, are 50 feet deep and 22 feet between centres. They are divided into sixteen panels of 25 feet each. The truss is of the double Whipple type with inclined end posts. The bridge is proportioned to carry a train weighing 2,000 pounds per lineal foot, preceded by two locomotives weighing 150,000 pounds in a length of 50 feet. The pins connecting the members of the main truss are five inches in diameter.—John Bogart: "Feats of Railway Engineering" in "The American Railway."

THE SMALL TRESTLE OR BRIDGE MORE FRUITFUL IN ACCIDENTS THAN THE LARGER STRUCTURES.

It is the small trestles and bridges which, in consequence of neglect, create accidents. Short and apparently insignificant trestles and bridges cause accidents at times of an astounding nature. Early recognition of the causes of accidents suggest common-sense ways to prevent their occurrence, and it is safe to say that it is rare indeed for any prominent railway to have two serious accidents of the same character occur unless rapidity of time debars prompt action.[1]

BRIDGE ACCIDENTS COMMENTED UPON.

Adams, "Notes on Railway Accidents," says: "Long and varied and terrible as the record of bridge disasters has become, there are, nevertheless, certain and very simple and inexpensive precautions against them, which altogether too frequently corporations do not, or will not, take. . . . The sustaining power of a bridge is of course a question comparatively difficult of ascertainment. A fatal weakness in this respect may be discoverable only to the eye of the trained expert, and, as asserted before, probably three-fourths of the truss bridges are now of iron and steel, and may be considered perfectly safe as long as trains remain upon the rail and do not strike the side trestle. The Desjardins Canal disaster upon the Great Western Railroad of Canada, where sixty out of ninety persons were killed, resulted from the derailment of an engine on the bridge."

---

[1] Everything not covered with earth, except cattle-guards, be the span ten or forty feet, is called a bridge. Everything covered with earth is called a culvert. Wherever we are far removed from suitable quarries, we build a wooden culvert in preference to a piled bridge, if we can get six inches of filling over it. Then culverts are built of roughly squared logs and are large enough to draw an iron pipe through them of sufficient diameter to take care of the water. We do this because we believe we lessen the liability to accident and that the culvert can be maintained after decay has begun much longer than a pile bridge with stringers to carry the track.—Whittemore.

T. C. Clarke, *loc. cit.*, commenting on this said: "First, that it is better to use temporary wooden structures to be afterward relieved in good stone rather than to build of the stone of the locality unless first-class. Second, that a structure covered with earth is much safer than an open bridge; which, if short and apparently insignificant, may, through neglect, be a most serious point of danger, as was shown in the dreadful accident of 1887 on the Toledo, Peoria & Western Railway in Illinois, where one hundred and forty persons were killed and wounded, and by the equally avoidable accident on the Peoria and Savannah line in March, 1880. Had these trestles been changed to culverts covered with earth, many valuable lives would not have been lost."

We will not at this juncture speak of the passage of trains through open drawbridges, which are attended with as many harrowing details of personal injury as any kind of accidents in connection with the railway, since they invariably arise in consequence of negligence, disobedience of orders, or the mental condition of operatives. Extra precautions at present exercised regarding signals and other devices seem competent to lessen their occurrence. The interlocking bolt is now used on bridges for holding rails and ties in place, and to prevent the bunching of ties, as they can only be removed by tearing through the rough fibrous wood contained in the angle between them.[1] In addition to the use of interlocking bolts, there are inside guard rails which serve the purpose of keeping the rails ranged in line until the train can be stopped. There is also the rerailing frog, by which derailed trains are rerailed; and stout timber posts are placed at either end of a bridge on a line with the trusses, which are designed to stop any derailed vehicle which might strike against a truss and destroy it.

---

[1] In 1853 an express train went through an open draw at South Norwalk, Conn., and forty-six lives were lost. This, one of the most serious railway accidents that ever happened, is still remembered as an historical calamity. A new bridge now stands on the same site where this accident happened. In May, 1888, a west-bound express train, consisting of an engine and seven cars, was derailed just as it was entering the draw span. The train ran 300 feet on sleepers before it was stopped. Then it was found that all of the driving wheels of the engine had regained the rail, but all outer wheels were off except those of the two sleeping-cars in the rear. This was a remarkable escape from a bad accident, and much of the credit of it has been given to the interlocking bolts with which the rails were fastened. They are supposed to have prevented being crowded aside and thus to have made possible the rerailing of the engine; besides, they helped the oak guard pillars to hold the ties in place. The destruction of a bridge in an accident frequently begins by the ties bunching in front of the wheel and allowing the wheels to drop through and strike the floor beams below; for this reason guard timbers notched down over the ties should always be used.—H. G. Prout, *loc. cit.*

MANIPULATION OF TRAINS AS A CAUSE OF ACCIDENT.

Another source of accident upon the railroad is the manipulation of trains upon the main line of the road. The common practice in this country is to have them under the control of train-despatchers by time intervals. The greater number of the lines in this country are single-tracked; hence, this system of train-despatching assumes great importance, and the train-despatcher becomes the most important, and at times responsible, employee of the railroad company. The block system is used on very few lines in this country; and though it is considered to be altogether safer than the present method, it, too, does not seem to give immunity from rear-end collisions. Mental conditions of the train-despatcher and operator are constant causes of accident; they are liable, through the inroad of any acquired, inherited, or predisposing disease, to various anomalous mental conditions. It is a noted fact that with all the extra care and precaution in the repetition of messages received, and the duplicates furnished officials and employees, peculiar mental conditions are constantly liable to crop out; notably the one which we have previously referred to, "heterophemy," which, as has been shown before, has been the occasion more than once of producing a catastrophe with consequent loss of life. Oftentimes incorrect orders are transmitted by the train-despatcher in consequence of excessive exertion and lack of rest; at times his error is as much his own fault as that of the officials. Neglect and disobedience of train crews, in not paying due attention to explicit rules conspicuously placed in every position where memory can be refreshed, are responsible for accidents.

NEGLIGENCE OF EMPLOYEES AND DISEASE AND OVERWORK AS CAUSES.

Irregular and rapid running upon the part of heavy, large, and imperfectly equipped freight trains; imperfect brakes; bad order of cars, at times causing the breaking in two of trains, are fruitful causes of accident. The disobedience of orders to clear the siding; mistakes in time, notwithstanding the rule for trainmen to compare watches, and to allow five minutes for mistakes at meeting points; incorrect reading of orders upon the part of engineers and conductors, due in many instances to mental conditions allied to heterophemy, and at times to those incidental to intemperance—often occasion disaster. Many errors arising from mental conditions bring about dangerous positions, and, according to circumstances, may produce personal injury or death. To enter into a full consideration of the causes pertaining to mental conditions which are at the basis of many accidents would be to give a history of diseased conditions, and any endeavor to analyze these mental conditions would require more space than is at present available. Accidents not infrequently arise in consequence of poor official judgment, where operatives of trains are compelled by the arrangement of schedules to work beyond their physical endurance; and this is particularly so in the warmer seasons of the year. It is immaterial whether this arises from the willingness of the employees to undergo undue physical effort, or whether they are compelled by officials to work beyond their physical endurance.[1] When employees have exceeded all due bounds in their labor they are in a mental and bodily state of instability. The body oppressed by excessive labor deleteriously influences the mind, hence normal effective accomplishment is not attained and accident is a constant attendant upon their work. "Asleep on duty" means utter ineffectiveness. Intemperance in work as exemplified in overwork, lack of discipline, neglect of duty, disobedience of orders, wanton wilfulness, aberrant mentality, seem, as a rule more productive of catastrophe than do erratic machinery and defective materials.

---

[1] Overwork on railways is highly dangerous, both to servants and passengers. Ten hours a day of railway work, considering its importance, should be sufficient; and care should be taken that proper time for rest, say eight or nine hours, is allowed before each term of duty. Signalmen should not be called upon to work more than eight hours continuously; and at very busy and large junctions six hours is as much as should be required. It is not a question of how many hours a man can work, but of how many hours he can work efficiently and safely; and any railway servant who has been on duty fifteen, eighteen, or twenty-four hours is not and cannot be in a fit condition to devote that sole attention to his work which its importance so much demands.

Major Marindin reported to the Board of Trade: "It is not difficult to account for the conduct of these men, who, I feel convinced, must have been asleep, or nearly so, upon the engine; for they had at the time been on duty for nearly sixteen and a half hours. It hardly needed this accident to show the enormous risk which attaches to the employment of drivers for these inordinately long hours, for it has often been pointed out in previous similar cases; and apart from this it should be patent to all that there is a limit to human endurance, and that a driver cannot be considered to be in a fit and proper state to perform his very responsible duties after working for such a length of time"—"Safe Railway Working," by C. E. Stretton, C.E. Pub. by Crosby, Lockwood & Son, London.

THE RULES OF TRAIN-DESPATCHING, IF RIGIDLY FOLLOWED, A PREVENTIVE OF ACCIDENT.

The general principle of train-despatching, if duly observed, will prevent collisions; but never-ceasing care and strict discipline constitute at all times the greatest element of safety in railway management.[1] The present code of rules by which trains are manipulated, and the signals now generally used in this country, have been formulated by committees and approved by national railway conventions.

SIGNALS—THE SEMAPHORE AND THE INTERLOCKING SWITCH CONSIDERED.

In preventing accident, timely information of the need to stop trains, which is conveyed by signals used to protect points of danger, to govern the movements of engines in yards, and to keep an interval of space between two trains running on one track, is of the greatest importance. The semaphore signal[2] has become a standard in this country. In yards there is an arrangement of signals and switches in such a way that their movements are made mutually dependent, as exemplified in the interlocking of switches. Interlocking has become a special science and has made it possible to concentrate levers which move switches and signals into one place and under one management. It is a mechanical impossibility for a signal-man to give a signal which would lead to a collision or derailment within the region under the control of the interlocking station. These devices come mainly within the scope of local detection in the manipulation of cars, the arrangement of trains, and in switching for various purposes. Yard accidents are very frequent and individually severe, consequently presenting fatal features, more so in proportion to the number of men employed than almost any other position in railroad service. Coupling accidents are exceedingly common, owing to the various forms and sizes of car couplers, broken couplers, and "bad order" cars. There has been a constant effort upon the part of the management of railways to eliminate the element of human agency whenever and wherever it can be done with safety. In spite of the existing rules, which, if rigidly followed, would be preventive of accidents, owing either to a lack of discipline or mental conditions, accidents are of constant occurrence, and hence the effort to introduce the block-system. But, as previously mentioned, it has been found that even an absolute block-system, as at present devised, is defective as a protection against rear-end collisions; and it is a common matter of observation that where human agency is depended upon the rear-end collision will be of frequent occurrence. From statistics obtained from various sources, it has been computed that in 1892 there were 231 rear-end collisions, and about one-half of these were instances where a freight train ran into the forward train. There was only one employee killed and two wounded, while we find 23 passengers killed and

---

[1] First and most important, no train must ever under any circumstances run ahead of time; next, any train making a stop not in its schedule must immediately send out a flagman with a red flag during the day, and a red light and torpedoes at night, to protect. Now when a train is prevented from arriving on time at its meeting-point there must be some rules by which the opposing train may proceed, or all business on the road would be suspended by the delay of a single train. Only the general principle of these rules can be stated within limits. They are as follows: First, all freight trains must wait indefinitely for all passenger trains. Secondly, where one train only is behind time, the opposing train of the same class will wait for it the specified time, usually ten minutes, and five minutes more for possible variation in time, then go ahead, keeping fifteen minutes behind its schedule. Thirdly, should a train running on delayed time lose more time, or in any way should both trains get behind time, then the one which is bound in a certain direction, for instance north, has the right to the track, and the other must lie indefinitely.

[2] This consists of a board, called the blade or arm, pivoted on the post, and back of the pivot is a heavy casting which carries a colored glass lens, either green or red, on the post-hanging lantern. The danger position is with the blade horizontal. In this position the lens is on the point of the lamp, and the light shows red or green as the case may be. The safety position is with the blade hanging about sixty degrees from the horizontal. In this position the light of the lantern shows white. Red is the universal color for danger, and green the color for caution. Therefore a semaphore signal at a point of danger shows by day a blade painted red with the end of the blade cut square. At night it shows a red light at a position some distance from the point of actual danger; but when it is desirable to warn an engineer

---

that he is likely to find danger ahead, a cautionary signal is placed. This is a semaphore blade painted green with the end notched in a V-shape, called a fish-tail. At night this signal shows a green light. There is nothing very remarkable about a piece of board so arranged as to wag up and down on a pin stuck through a post, but it is wonderful how much of good brains and good breath have been expended in getting these boards to wag harmoniously and to get railway officers to understand that a plain board having two possible positions is a better signal than any more complicated form.—Prout, *loc. cit.*

132 wounded, in the rear-end collisions, obviously for the reason that employees were generally competent to see the impending danger and seek safety, while the passengers most frequently met it unawares.[1]

CAUSES DUE TO DEFECTIVE MOTIVE POWER.

Having thus far considered the cause of injuries arising on railways mainly in connection with the road's integrity and the manipulation of its trains, it is but natural to pass to the consideration of some of the causes due to defective motive power and rolling-stock. The locomotive was the real incentive and cause of the railroad, and in proportion to its power in its normal condition is the most amenable piece of machinery ever devised by man; but under adverse conditions it is competent to create the most appalling catastrophes. In its construction, its every element is tested from its start to its completion, and that under skilled supervision; when in operation, a studied care eternally surrounds it. While the breakages of its parts are numerous, it is indeed rare to have any very serious accidents follow in consequence. Its axles may break; its driving tires, its flanges may break; its side-rods may snap and dismantle the cab and injure fireman or engineer. Explosion of its boiler is so infrequent as to be a surprise; and, as a rule, its accidents are more dangerous to the engineer and fireman than to any one else. This is mainly dependent upon the Westinghouse automatic brake. It is by this brake that the engineer has time and time again prevented collisions, and saved not only his own life but the lives of others.

Defects in rolling-stock are a cause of accident, and at times lead to positive catastrophes, depending of course upon the position and condition of the track where the accident occurs. Not infrequently there is breakage of axles of cars, or a bent axle may be followed by disaster, as in the Angola horror; broken flanges, broken brakes, and defective couplings are a constant source of accident.

---

[1] Bulletin No. 12 of the Interstate Commerce Commission, which includes the months April, May, and June, reports twenty-seven train accidents of which eighteen were collisions and nine derailments. Out of these twenty-seven train accidents twenty were caused by defective mentality upon the part of the railway employee. The bulletin of the commission for the months of July, August, and September, 1904, shows out of twenty-four collisions eighteen which were traceable to mistakes or neglect upon the part of the employee.

INSPECTION OF TRAINS—MILLER PLATFORM—WESTINGHOUSE BRAKE.

Constant inspection of all wheels, particularly of passenger coaches, at stated points along the line, is demanded and constantly enforced. All parts of a passenger train are thoroughly inspected before leaving, and its inspection is continuous to the termination of the journey. Rewards are offered and paid for finding defects. The modern passenger train certainly combines in the most exalted degree results of the most careful study. Of these perhaps the Westinghouse automatic brake is the most remarkable. It has the marvellous capacity of stopping a train of cars one-third of a mile long, going at the rate of speed of forty miles an hour, smoothly, without jolt or jar, in one-third of its own length. This brake has been the cause of preventing more catastrophes that would have resulted from collisions and derailments than any device ever placed upon a railroad; and as a life-saving factor no device equals it. Indeed, no one praises its virtues more than the engineer whose daily contact with it makes him pronounce it, beyond all comparison, absolutely the most perfect safety device for himself and those whom he carries under the guidance of the locomotive. The Miller platform and coupler is another device which has saved many myriads of lives. And now the vestibule has been added, which enables the perfect ventilation of crowded trains, and debars the possibility of falling off trains while in motion. This new device will undoubtedly prove a most potent factor in preventing the production of that comparatively frequent trouble known as "traumatic neurosis." It has already been demonstrated that by its great springs it diminishes the dangerous element of concussion attendant upon collisions, by neutralizing the shock of propelling forces; and it prevents the possibility of telescoping.[1]

---

[1] The vestibule was devised as a safety appliance for the protection of human life in case of collisions. General Horace Porter, of the Pullman Palace Car Company, thus speaks of it: "It consists of frictional buffers or frame plates, practically the height of the car and projecting normally beyond the ends of the car and supported by the buffer springs below, and re-enforced by powerful springs at the top of the car. These frames are connected with the car at the sides by elastic diaphragms. When two cars are brought together and coupled the faces are the bearing

NATURAL PHENOMENA AS A CAUSE OF ACCIDENT.

We will not attempt to enter into details regarding accidents where natural phenomena act with such suddenness as to debar the possibility of human anticipation or protection; where, oftentimes, in spite of the closest attention to every detail and almost perfect discipline, serious accidents occur in consequence of abnormal and unforeseen conditions that suddenly arise. Where trains move over wide and unprotected spaces with rapidity; where physical conditions of a country are developed at times into abnormal conditions; where, in mountainous regions, there is possibility of landslides, or that large trees or large stones may topple over on the track directly in front of trains, there may be no opportunity to avoid accidents. Water-spouts, and floods creating washouts, while trains are in transit between stations, are beyond the power of human anticipation. Thus varying extents of tracks, trestles, culverts, or even bridges may be suddenly destroyed. We recall many instances of this nature, particularly one where a culvert was washed out not more than ten minutes after inspection, and the next train was ditched, killing some four persons and injuring thirteen more. Again, where physical conditions seem to present every element of safety, disasters of this nature will sometimes occur. Thus we have seen three hundred feet or more of railroad track, built upon solid rock, washed out in but a few moments, derailing

surfaces of the steel frames which are pressed by the springs against each other, and the friction thereby created is sufficient to hold them permanently in position and to prevent the oscillation of cars. There is thus furnished a substantial buffer extending from the platform to the roof, which precludes the possibility of one platform riding the other and producing telescoping in case of collisions. Authentic records show that in about a dozen instances in which such trains have been in collision at a rate of speed even as high as fifty miles an hour, the buffer plates and springs have taken up and distributed the shock through their spring resiliency, and prevented crushing or destruction of any portion of the car-bodies. In no instance has any passenger been seriously injured, and the cars have escaped with only trifling damage. In one of the worst of these collisions a passenger was standing in the vestibule and suffered no injury whatever. These escapes without loss of limb or life to passengers and with trifling expense to the railway companies have attracted marked attention. The friction upon the frame brakes is sufficient to prevent the oscillation or swaying of the cars from side to side, and adds largely to the general steadiness of the train when in motion. This has had a decided effect in preventing nausea from which so many passengers suffer in trains running at high speed over reverse curves. While the primary object of the vestibule was to create a safe and convenient passageway between the cars, the perfecting of the device has resulted in a safety appliance of inestimable value."

the engine, overturning cars, and killing three persons and injuring fifteen more.

Classification of the Causative Factors of Railway Injuries — Explaining Why the Terms Kinetic-kinesic, Bi-kinesic, Mono-kinesic, Un-kinesic Are Used.

There has been no endeavor upon the part of writers to classify the causative factors of railway injuries. The writer conceives that system is needed in this direction, since a proper classification, and an attempted correct naming may be the means of establishing a quick comprehension of the forces which have been engaged in producing railway injuries. It must be understood in the beginning that all railway injuries are the result of force or energy in motion. Hence, their study must be made under kinematics, that division of mechanics which treats of the movements of bodies without reference to the forces which produce the movement. The effects of kinetic energy, or energy in motion, being the cause of railway injuries, the writer will attempt to classify these injuries according to the character of kinetic energy manifest at the time the individual or individuals are injured, with special reference to the kinesic condition of the injured individual more than the kinesic state of the inflicting agent. Railway accidents, then, will be classified under four different headings: 1st. Accidents arising from kinetic-kinesic states. 2d. Bi-kinesic. 3d. Mono-kinesic. 4th. Un-kinesic. 1st. The kinetic-kinesic accident is where the mechanical agent, railway train, locomotive, etc., is primarily in kinetic energy, and the injured individual is under kinesic sway, that is to say, being conveyed by the mechanical agent, such as railway trains, locomotives, cars, hand-cars, etc., as shown in collisions, derailments, parting of trains, backing up of trains, jerking of trains, and switching of trains. 2d. Bi-kinesic, where both mechanical agents and injured individual are successively kinesic. The kinetic energy of the mechanical agent, along with gravity, imparting an additional kinesic energy to the injured individual in process of injury, such as jumping on or off of moving trains, cars, locomotives, falling from trains, cars, locomotives, etc., while in motion, being struck by bridges, trestles, switch-stands, etc., while on moving trains. 3d. Mono-kinesic, where the injured individual from cause becomes kinetic as from falling from standing trains, locomotives, etc., falling from scaffolds, telegraph poles, falling into pits, falling to the ground, in consequence of unstable footing. 4th. The un-kinesic, as being struck by flying missiles as from explosion of boilers, engines, grind-stones, etc., rocks thrown through coach windows, getting on track and being struck by approaching cars, engines, etc.

Under the head of accidents occurring in kinetic-kinesic states are included all accidents, purely of a vehicular nature, such as collisions, derailments, parting or breaking in two of trains, backing of trains, sudden jerking of trains, etc. There were 6,407 accidents of this character, with 385 deaths. Bi-kinesic accidents, where both mechanical agent and injured individual are successively kinetic, the primary kinesic condition of the agent, that is, moving train, locomotive, etc., along with gravity imparts additional kinesic energy to the individual in process of injury. This form of accident includes such accidents as falling off moving trains, locomotives, cars, etc., jumping on and off moving train, cars, etc., struck while on moving train by moving train in opposite direction, struck while on moving train by switches, trestles, bridges, etc. Bi-kinesic accidents numbered 4,615 injuries, with 441 deaths. In proportion to the number of injured in this form of accident, it is uniformly the most fatal owing to the fact that there is almost a reduplication of the primary energy when accident terminates. The mono-kinesic form of accident is where from cause the injured individual becomes kinetic, as in falling from standing trains, cars, etc., falling from bridges, trestles, scaffolds, falling into pits, cattle guards, falling from telegraph poles, falling to the ground from unstable footing. This is the least fatal form of accident. They were numbered 3,768 injuries, with only 49 fatalities. The un-kinesic accident is where the individual is in a more or less quiescent state, while the inflicing agent is in a state of kinetic energy; this form of accident includes repairing machinery, cars, engines, bridges, and buildings, handling company material such as coal, rails, ties, lumber, etc., such as coupling and uncoupling cars, etc., dropping articles on different parts of the body, struck by different agents in kinetic energy, such as trains, cars, etc., explosion of boilers, torpedoes, grind-stones, firearms; shot by train robbers, tramps, and persons unknown, struck by lightning, cyclones, etc. Un-kinesic accidents numbered 67,573 injuries, with 2,248 fatalities.

The list of railway accidents tabulated by the writer is as follows. There were three different classes:

73,549 employees injured, with 1,585 deaths; 5,529 trespassers and citizens injured, with 1,379 deaths; 3,293 passengers injured, with 159 deaths, making in all 79,239 non-fatal accidents and 3,123 fatal accidents. The total number of injured then was 82,361.

The Difference between Citizen and Trespasser.

Under the head of injuries to "citizens" and "trespassers," it must be noted that two classes of persons are here considered. The "citizen" is generally injured by the train frightening the horses which the "citizen" may be driving or when the "citizen" attempts to cross the railway tracks, and is run down by train, car, or locomotive. The "trespasser" is one who courts injury by going upon the railway company's right of way, attempts to cross between cars, or gets on railway company's trains without permission and with no desire to pay for passage; in common parlance, attempts to beat his way. Or he gets upon the track in front of trains, frequently when drunk, or sleeps on the track. The "trespasser," as a general thing, is of the tramp species. One of the most noted points in the above list is the great difference in the mortality between the "citizen" and the "trespasser," on the one hand, and passenger or employee, on the other hand. It will be noted that out of 5,479 injuries to the former class, there were 1,379 fatalities: almost one out of every four injuries were fatal. These fatalities arise from the fact of the great danger in which trespassers place themselves, as by getting on the track in front of trains and engines, jumping on and off trains in motion, and frequently being thrown off moving trains by company's employees.

Remarks as to Manner of Injury Occurring to Citizens and Trespassers.

It has been already stated that the cause of the extreme mortality occurring in injuries to citizens and trespassers arises from the extremely dangerous positions in which they are placed, as well as their mental condition, since it is established that many of their injuries arise in consequence of these persons going on the company's track or right of way when drunk or in mental moods courting destruction. The different headings of the manner of injury are self-explanatory. Injuries to "citizens" and "trespassers" occurred in seventy-six different manners: horses frightened and running away, injuring drivers, 41, with 1 death; walking on track 630, with 256 deaths; crossing between cars 331, with 23 deaths; crossing tracks 153, with 37 deaths; self-destruction 14, with 14 deaths; asleep and sitting on track 152, with 59 deaths; found on track 152, with 137 deaths; injured on right of way 79, with 9 deaths; injured on trains 123, with 6 deaths; falling from moving trains 211, with 35 deaths; falling from trains 157, with 29 deaths; struck by hand-cars 120, with 52 deaths; struck by passing trains 1,049, with 299 deaths; struck by switch-stands 33, with 7 deaths; run over by trains 115, with 39 deaths. Collisions 139, with 31 deaths; derailment of trains 203, with 25 deaths; coupling and uncoupling 36, with 2 deaths; jumping on standing trains 35, with 1 death; jumping on moving trains 446, with 62 deaths; jumping from moving trains 487, with 62 deaths; jumping on trains 66, with 7 deaths; jumping from trains 47, with 10 deaths; unknown 407, with 150 deaths.

Manner of Injuries Occurring to Passengers.

According to list tabulated 3,293 passengers were injured, and there were fifty-eight different ways in which they were injured. It can be said with truth that the passenger, like the rest of mankind, is more or less inclined to expose himself to danger where no necessity exists. His curiosity leads him into dangerous places, and injury is the result. He is constantly prone to exercise poor judgment, thus courting injury and death as well. At times he assumes duties of railway employees and thus injures himself. The following are some of the ways in which the passenger is injured: Sudden jerking of trains caused 115 injuries, with 1 fatality; while alighting from trains, 28 injuries; walking on track, 23 injuries, with 3 fatalities; car door, window, chair-seat accidents, 158 injuries; struck by flying missiles, 47 injuries; struck by switch-stand, mail-cranes, etc., 84 injuries, with 3 deaths; crossing between cars, 29 injuries, with 2 deaths; falling from moving trains, 140 injuries, with 19 deaths; falling from standing trains 119, with 2 deaths; injured on train 105; jumping from moving trains, 115 injuries, with 9 deaths; jumping on moving trains 165, with 16 deaths; jumping on and off standing trains, 59 injuries, with 3 deaths; collisions caused 949 injuries and 54 deaths; derailments, 891 injuries, with 13 deaths; self-destruction 2, with 2 deaths; climbing down ladder of cars, coupling and uncoupling cars, 5 injuries; crossing track from car to car and crossing track caused 37 accidents. Collisions caused only 949 injuries, leaving 2,402 injuries to be caused by derailments and other ways.

Character of Vocation among Railway Employees to Whom Injuries Most Frequently Occur, Along with Manner of Injury.

The railway employs in its service almost every vocation, and in the list tabulated there are no less than one hundred and twenty-eight positions occupied by the employee. Space will allow the writer to mention only the prominent classes most frequently injured. There were 10,150 injuries to brakemen, 406 resulted fatally; 1,077 to boiler-makers, with 2 fatalities; 1,811 to B. & B. carpenters, with 15 fatalities; 1,715 to carpenters, car carpenters, carpenter helpers, and carpenter apprentices, with 2 fatalities; 2,936 to car repairers, with 22 fatalities; conductors were injured to the number of 1,379, with 33 fatalities; 2,501 engineers injured, with 97 fatalities; 5,151 firemen injured, with 122 fatalities; 1,982 extra gang laborers, with 29 fatalities; 2,952 laborers, with 24 fatalities; 4,920 machinists, machinists' helpers and apprentices injured, with 2 fatalities; 9,530 section laborers, with 166 fatalities; 1,214 section foremen, with 14 fatalities; 2,337 switchmen injured, with 71 fatalities; 1,146 shop laborers, with 5 fatalities; 3,197 yard laborers, with 60 fatalities; 990 coal-heavers, with 6 fatalities; 564 freight-handlers, with 2 fatalities; 371 hostler helpers, with 2 fatalities; 522 train porters, with 7 fatalities; 336 painters and helpers injured, 1 fatally; 420 injured round-house employees, with 3 fatalities; 434 truck-repairers, with 2 fatalities; 437 truckers injured, 1 fatally; 235 telegraph linemen, with 2 fatalities; 419 watchmen, with 14 fatalities; 991 wipers, with 8 fatalities.

It will be seen that 2,501 locomotive engineers were injured as compared with 5,151 locomotive firemen. Since they both occupy the engine cab it would be a pertinent inquiry why more firemen were injured than engineers. As a rule, the engineer sticks to his seat box; the fireman passes backward and forward between cab and engine, thus making use of unstable footing and placing himself in the power of gravity. By the manipulation of the coal the firemen frequently have their fingers and hands damaged. It is quite usual to find more than double the number of firemen injured, but generally the engineer's injuries are of a more fatal character than the fireman's.

As to the manner of injury, we find that in coupling and uncoupling cars, 5,452 injuries occurred, with 155 fatalities; 1,266 were injured in collisions, with 80 fatalities. Derailed trains caused 1,357 injuries and 77 fatalities; backing and parting of trains, crossing from car to car, 427 injuries, with 8 fatalities; repairing machinery caused 15,990 injuries, with 49 fatalities; cleaning cars, engine yards, 445; handling coal and company material, 12,438, with 7 fatalities; falling from moving trains, standing trains, telegraph poles, scaffolds, trestles, etc., 3,903, with 205 fatalities; jumping from moving trains, car trestles, etc., jumping on moving trains, etc., 4,950 injuries, with 89 fatalities; struck by trains, cars, missiles, run over by trains, 7,568 injuries, with 229 fatalities. Minor accidents numbered 6,794, with 43 fatalities; stepping on rocks, boards, etc., 1,025; handling and dropping miscellaneous articles, 731; explosions of torpedoes, firearms, etc., 562 injuries, 12 fatal; loading and unloading cars, 584; sudden stoppage of cars, 227 injured, 1 fatally; crossing between cars, 279 injured, with 18 fatalities; personal conflict, 302 injured, 1 death; heavy lifting, 813. Among the unusual accidents: struck by lightning 10; shot by train robbers 4; cyclone injuries 9; explosion of engine 37, 16 fatal; self-destruction 12, with 11 deaths; not specified 174, with 9 deaths. Ejecting persons from cars, 20; walking on track, 345 injuries, with 53 deaths.

WHY RAILWAY WRECKS UNDER PRESENT CONDITIONS WILL BE OF FREQUENT OCCURRENCE.

Notwithstanding the multiplicity of the improvements suggested and adopted in the manipulation of railways, for the prevention of accidents, these devices have apparently in no manner lessened the constant occurrence of train accidents. It can be stated as an absolute fact that in the manipulation of railway trains where speed is the essential and imperative factor, mental continuity and uniformity are the only real and effective safeguards in the prevention of many such accidents as collisions, derailments, etc. It can be stated with equal truth that so long as the employee's mind is subject to aberration and erratic action just so long will railway accidents occur, for man's mind is constantly fallible when organic disequilibrium is so constantly manifest. To the great mass of men seconds, minutes, and even hours of mental uncertainty, inattention, and absent-mindedness mean a natural, necessary, and harmless mental relaxing process; but with the engineer, train-despatcher, conductor, etc., who manipulate trains, speeding through space from seventy-five to one hundred and fifty feet a second, mental preoccupation, inattention, or absent-mindedness indulged in, even for seconds or minutes, may lead to death-dealing wreck and catastrophe. Year by year, notwithstanding all the experience gleaned in the past in the handling of fast-moving railway trains, accidents such as collisions, derailments, bridge accidents, etc., are as uninterruptedly frequent as they have been in the past. This being so, the thought is naturally suggested, what are the causes leading to constant and uninterrupted catastrophes through errant mentality on part of the employee? The writer believes that railway accidents arising from defective mentality on part of the employee have their origin in and through defects and idiosyncrasies of *attention*. The railway employee in the transportation department is selected for the sole purpose of being able to follow out and carry into execution well-defined and plainly stated instructions. In other words, he is employed because he is known to have effective command of his attention. It has been established and demonstrated that he, the employee, is competent, through training and education, effectively to direct his observations and thoughts to a particular object; that he has trained his will to fix his attention so as to keep one idea firmly in view, while others may come and go unheeded. *Keen attention* is demanded of the engineer, the fireman, train-despatcher, etc. That is, they are required so to concentrate their attention as to be almost wholly oblivious to their surroundings. With *normal attention* we are only to some extent oblivious to our surroundings. This does not do for the vocation of locomotive engineer. In *lax attention* we are guided almost solely by casual impressions derived from our surroundings. The factors producing changes in the field of attention are many and varied, even without pathological condition, hence, since trains speed through space with almost incredible velocity, and man's attention is normally made for use in environment far less speedy, accidents must occur on single-line roads so long as human agents are used. Again, the physical or organic integrity of the railway employee, like the rest of humanity, constantly influences and modifies his mental operations and especially the attention. Mental worries, overwork, the insidious undermining action of forming disease, either acquired or inherited, transient organic disturbances, loss of rest, aberrant influence of stimulants, and the still undetermined yet positive influence of kinetic surroundings, are all competent to beget errors of attention, aberrant mentality, thus creating catastrophe. Among the modifying factors changing the field of attention may be mentioned the occurrence of a strong sensation competing with attention; and, in the writer's opinion, the sensations engendered by kinetic elements have positive influence.

A study of the forces used in the operation of the railway, especially in the running of trains, is essentially a study of kinematics—the science of motion, or, as before expressed, the division of mechanics which treats of the movements of bodies without reference to the forces which produce the movements. Thus, a railway train in motion is in kinetic energy, and the person conveyed by this train, or other agent, is under kinesic sway. There can be no doubt that trains in kinesic states, or trains in motion, have an undoubted influence upon the mentality of man. The passage through space upon a fast-moving train produces upon man sensations definite and characteristic. First there comes a sense of exhilaration, followed by a more or less soothing influence leading to lax attention, where casual impressions derived from surroundings have sway. This influence is manifest both upon employee and passenger. The constant and unceasing play of kinetic agents, with their soothing and placating elements, must more or less constantly influence the mentality of the employee. How many accidents are produced by this cause may never be determined, but that it is a power in overthrowing *keen attention* there can be no doubt. *Keen or overwrought attention,* such as is frequently exercised by the engineer, train-despatcher, etc., always has a limit to its exercise; consequently it cannot be exercised continuously; it must sooner or later run into lax attention. No man is so constituted that he can concentrate his attention continuously, and be wholly oblivious to his surroundings. The more intense and continuous is the use of attention, the sooner it must, as a general thing, lapse into lax attention.

When it is considered that, in running fast trains, *keen and unremitting attention* is demanded, that man as he is normally made naturally has frequent lapses of attention, and that seconds of time are fraught with danger if occurrences are not closely watched, there need be no wonder at the constant occurrence of wrecks, in view of the many physical and mental conditions which influence the attention.

The conditions are incompatible with perfect train-running. Hence, so long as fallible human agents are depended upon, just so long will train wrecks occur.

CONCLUSIONS.

While realizing that this portion of the subject is presented more in a historical than a medical light, we believe that it has an important medical bearing. The close study of causes in railway accidents certainly imparts greater scope of knowledge, not only clinically, but in a protective way. The study of the general characteristics of an agent capable of inflicting injury to the human economy not only saves the surgeon from the contumely of an incorrect prognosis, but it is an intelligent aid in treatment, and a positive defence against future adverse criticism or a suit for malpractice. Everything in connection with these injuries should be examined. The same painstaking study of details which leads the specialist to nicety of results is pre-eminently needed in railway injuries. The inspection of the apparel worn by the individual at the time of the injury has saved the writer from the contumely of an erroneous prognosis more than once. A shoe worn by the person at the time of an accident has told the extent of force and compression exerted on the injured member far better than the condition of the part injured. Thus, in railway injuries the inflicting agent should be studied with every other detail, including the possible mental element; for results oftentimes hinge upon the proper interpretation of all these factors.

It can be said with truth that in general the lawyer and the physician confine themselves too closely to the limits of their respective vocations; that is, the lawyer, while very profound in law, is usually very superficial in medicine; the physician, pre-eminently learned and practical in medicine, is ordinarily "nil" as to his knowledge of the law. While the extent of both law and medicine is ample excuse for the lawyer's ignorance of medicine and the physician's scant knowledge of the law, still the fact remains that there is a necessity for each of these professions to enlarge its knowledge in the field of the other.

In medicine a personal injury is studied with reference to cause as influencing its course and result; in law its cause is studied with respect to the question of liability. The lawyer seeks to solve the question of negligence as a causative factor, and to determine the extent of mental anguish and physical pain, the result as regards extent and permanency and loss of earning power. Negligence is the gist of every action for damages for personal injury, and when shown to exist authorizes a recovery, except when the negligence of the injured person contributed to the injury. To create a liability, negligence and a resultant injury must be shown. The mere concurrence of accident and injury does not show negligence, but an injury caused by negligent acts or omissions creates a liability for damage. The relation of cause and effect should be so intimate that the influence of the alleged causative act or omission should predominate over every other influence, and be in itself an efficient cause of injury. The study of causes in personal injury upon railways is of equal importance to both professions; aiding the surgeon by giving him a broader view of inflicting agents, and the lawyer by enabling him to form judgments based upon common sense and fact. In conditions engendered by railway accidents, the extent of suffering, mental and physical, the permanency of injury and all attendant adverse conditions, can be determined only by the experienced physician; and he can but ill perform his duty when he fails to take proper cognizance of the causes and effects of railway injuries in general and in particular.

CHAPTER II.

GENERAL DIVISION AND CONSIDERATION OF RAILWAY INJURIES.

1st. Railway injuries generally considered.—2d. The number of railway injuries tabulated by the writer—General character of the injuries.—3d. An analysis of so-called corporeal and psychic shock.—4th. A consideration with analysis of certain causative factors likely to result in shock.—5th. Why railway injuries are considered specially.—6th. Back injuries.—7th. Lumbar sprains and strains and so-called traumatic lumbago.—8th. Sprains, strains, and muscular-fibre rupture of the back.—9th. The regions involved in back injuries.—10th. Symptoms of lumbar strain and sprain.—11th. Strains and lacerations of tendons of the back and cervical region.—12th. So-called concussion of spinal cord.—13th. Traumatisms of the vertebral column.—14th. Distortion and dislocation.—15th. Isolated dislocation of the lateral joint.—16th. Unilateral dislocation of the lateral joint.—17th. Contusions of the vertebral column.—18th. Isolated fractures of the arches, spinous processes, and transverse processes.—19th. Complete dislocation of fracture.—20th. Complete dislocation with fracture of the vertebral column with consequent spinal-cord lesions, especially complete transverse destruction.—21st. Traumatisms of the membranes of the cord.—22d. Extra-medullary hemorrhages (hæmatorrhachis).—23d. Traumatic hæmatomyelia.—24th. Concerning the use of the term traumatic syringomyelia.—25th. Locomotor ataxia.—26th. So-called concussion of the brain—commotio-cerebri.—27th. Cerebral depression.—28th. Traumatic epilepsy.—29th. Mental diseases following cranial injuries—traumatic insanity.—30th. Hernia.—31st. Injuries to the thorax, its walls and contents.—32d. Hæmaturia arising from back injuries.—33d. Position of kidneys a predisposing cause of injury.—34th. General causation of hæmaturia.—35th. Means of diagnosticating hæmaturia.—36th. Prognosis regarding ultimate effects of hæmaturia on kidneys.—37th. Illustration by cases in which traumatism produced ulterior effects.—38th. Medico-legal consideration of hæmaturia producing albuminuria.—39th. Infrequency of ulterior results.—40th. Conclusions.

RAILWAY INJURIES GENERALLY CONSIDERED.

THERE are no dividing lines between general surgery and so-called railway surgery. Diagnosis and course of the great bulk of railway injuries, like injuries arising from any other source, are comparatively simple; hence, there is seldom any occasion to admit of doubt as to their character, source, and consequences. In the examination by the expert of personal injuries resulting from railway accidents, it is necessary to determine whether the lesion under consideration is of a surgical nature, or secondary and subsequent upon the trauma produced. Where we have direct mechanical solution of continuity, under ordinary circumstances its interpretation involves a study of the normal effort at repair. We do not here refer to injuries presenting purely functional manifestations, traumatic in origin, but having no known organic basis, ill-defined, irregular, varied in outline, and placed under the heading of "traumatic psycho-neuroses, or functional disturbances of the mind and nerves." Medico-legally, traumatic psycho-neuroses are of unusual interest in relation to railway injuries, not alone because they were formerly considered *sui generis* to railways, but also in consequence of their comparatively frequent occurrence, their subjective nature and baleful consequences, their tendency to simulation, exaggeration, malingering, and the frequent litigation they cause.

As indicated before, plainly evident lesions of a surgical nature, where loss of parts, permanent disability, or deformity enters into the result, rarely need the interpretation of the expert. It would require more than ordinary ignorance in their investigation, a denseness and prejudice not ordinarily found in professional circles, not to arrive at a comparatively just conclusion. Still, questions of a surgical character may arise as to results obtained in given cases, as in amputations and compound fractures, for here extremes are constantly met. While usually indications are plain, yet the same general rule indiscriminately applied cannot be maintained regarding many procedures in railway surgery.

We realize in the beginning that in treating railway injuries we are not describing new and unknown affections, for, in general, the injuries occurring upon the railways differ from those inflicted in other ways only in certain modifying elements, *e.g.*, in degree and in the circumstances of their infliction. At times, however, the intensity of the forces and the peculiarities of the circumstances at work place railway injuries upon the plane of specialism. In no class of injuries inflicted upon man do we see so often the combination of the extremes of physical injuries and shock. Here we have great intensity of force producing excessive destruction of tissues and inflicting all varieties of contused and lacerated wounds and compound crushes of hard and soft parts. In many instances such injuries are inflicted under conditions peculiar to railways, *e.g.*, where excessive momentum, ponderosity, and rapidity of incident are characteristic. Frequently the active agent producing these injuries has an intense, definite character, weighing at times hundreds of tons and speeding through space at the rate of 115 or 150 feet per second. The passage of rapidly revolving ponderous wheels over the parts of the human economy certainly in many instances stamps the resulting injuries as original in degree. Tissues, vessels, and even nerves are twisted, ruptured, and strained at points far removed from the original seat of injury, requiring a study not only of the condition of parts obviously damaged, but also of the economy as a whole. Realizing how little systematic work has been done in the grouping of railway injuries and their medico-legal consequences, it shall be our endeavor to give observations concerning all the elements which enter into their production, course, termination, and consequences, aiming to indicate as plainly as possible the essential factors which constitute their truthful history.

We shall attempt to make their symptomatology as complete as possible in the hope of giving truthful views and enabling the expert or others to determine in their examinations any elements of simulation, pretence, or exaggeration.

THE NUMBER OF RAILWAY INJURIES TABULATED BY THE WRITER—GENERAL CHARACTER OF INJURIES.

According to tabulated list of railway injuries accumulated by the writer during the space of twenty-eight years, the following will indicate the number of employees, citizens and trespassers, and passengers injured: There are 82,361 injuries; 73,539, with 1,585 fatalities, occurred to employees; 3,293 injuries occurred to passengers, with 159 fatalities; 6,293 injuries to citizens and trespassers, with 1,379 fatalities. The following table indicates the character of injury:

	NOT FATAL.			FATAL.			TOTAL.	
	Employees.	Citizens and Trespassers.	Passengers.	Employees.	Citizens and Trespassers.	Passengers.	Employees.	All.
Abrasions	1,338	98	94				1,338	1,530
Amputations	759	212	22	65	23	3	824	1,084
Burns	2,073	24	24	40		2	2,113	2,163
Concussions	202	71	43	30		8	232	354
Contusions	23,645	1,546	1,573	36	3	1	33,681	26,804
Crushes	5,426	378	100	112	31	8	5,598	6,055
Dislocations	905	39	39	3			908	986
Eye and ear	3,488	17	6				3,488	3,511
Simple fracture	4,281	541	62	92	26	3	4,373	5,005
Comp. fracture	544	37	12	54	6		598	653
Gunshot	112	13	10	12	4		124	151
Incised wound	1,439	29	34	2			1,441	1,504
Lacerations	13,614	914	661	34	62		13,648	15,285
Punctured wnds.	1,224	16	8	1			1,225	1,249
Sprains	11,517	212	431				11,517	12,160
General	1,387	3	15	1,104	1,224	134	2,491	3,867
Totals	71,954	4,150	3,134	1,585	1,379	159	73,539	82,361

Not fatal	79,238
Fatal	3,123
Total	82,361

AN ANALYSIS OF SO-CALLED CORPOREAL AND PSYCHIC SHOCK.

The dividing line between so-called corporeal shock and psychic shock is so intangible as to be difficult of description and demonstration, and if there be any essential differences, except in the manner of infliction, it cannot be lucidly determined through the symptoms which present themselves.

Symptomatically no difference can be shown between so-called corporeal shock arising from severe injury and psychic shock arising from profound emotional disturbances. Corporeal shock is a primary constitutional symptom of wound, while psychic shock is due to profound emotional disturbances; both are due to influences from without. Shock causes sudden depression of the vital powers; this depression primarily affects the nervous system, which in turn leads to a depression of the circulation, followed by contraction of the arteries generally, but more especially the capillaries and the superficial arteries. Profound emotional disturbance or a crushed knee-joint presents the same symptomatic picture. In both we have relaxation of the voluntary muscles, the sphincters are paralyzed and consequent voiding of urine and fæces, pulse slow, irregular, variable, breathing shallow and slow, extremities and cutaneous surfaces cold and clammy, face pale, mouth and fauces dry. These symptoms just described are undoubtedly due to injuries to nerves and consequent contraction of arteries, and if the injury is sufficiently severe the contraction may extend to the larger arteries instead of involving only capillaries and superficial vessels. Naturally, in proportion to arterial involvement is the likelihood of fatal termination.

Shock is not alone the gauge of the capacity of the injured person to resist damaging influences from without, but also an index of existing nervous states at the time of injury. The amount of psychic shock existing with so-called corporeal shock after severe railway injuries is an unknown quantity, and yet it is at all times a modifying factor. In railway injuries where combinations of psychical and corporeal shock exist, the results are correspondingly severe. When a person gets his foot caught in a "frog" or "switch," and is unable to extricate it, and compelled to see the approaching inflicting agent, such as an engine or cars, he always suffers from both psychic and corporeal shock, and as a general thing recovery is very slow, or more usually the termination is fatal. When such cases occur at night, the injured person, being unable to see the approaching agent, suffers less than when such accidents occur in the daytime. Temperament is a constantly modifying factor in the manifestation of shock; persons of a bilious or lymphatic temperament suffer less from shock than persons who are of a sanguine or nervous temperament. Women are less affected by shock than men. The young act well under injuries; they are depressed quickly and react in the same manner from shock, unless the injury is accompanied by hemorrhage. Shock in the aged is always an uncertain quantity; since they are so subject to organic troubles. The immediate effects are not excessively severe, but no one can tell what ultimate effects shock may have upon an old person.

The gravity of shock depends upon the extent of nerve injury, its situation, the existing condition of health at the time, and the combined influence of psychic and so-called corporeal shock. The old classification of shock into delayed, secondary, and halting has no significance, since it has been shown that these terms are misnomers and the conditions are dependent upon other causes, such as concealed hemorrhage, fat embolism, septic infection, renal congestion, and pulmonary œdema. The symptoms of shock manifest themselves immediately after the injury; the skin is pale and cold, the pulse feeble and quick, at times variable, breathing rapid and shallow, the mouth and fauces dry, voice at times husky. There exists a feeling of faintness and depression, with general muscular relaxation, and patients are more or less dazed. Shock manifests itself in different degrees, from a slight feeling of sinking and weakness, with mental confusion, to complete collapse and death. Profound shock resulting from railway injuries in many instances presents peculiarities worthy of notice, the face pale, almost brilliantly so, eyes bright, clear, and alert, intelligence preternaturally active for a short time. The skin cold and clammy, covered with profuse perspiration, pulse almost imperceptible, breathing quick and very shallow, general muscular enfeeblement, sphincters paralyzed, voidance of fæces rare, retention of urine more constant than evacuation, nausea and vomiting constant and increasing with the approach of death. When the brilliantly pale face, the bright, alert eye, temporary mental exaltation, with other symptoms of shock, are present in a person with crushed extremities or equally severe injury, it invariably means death. The symptoms indicative of reaction from shock are a gradual return of the volume and strength of pulse, natural color and heat of skin, evidences of muscular power, heart's action becomes regular. The reaction generally returns gradually and is commonly attended with slight elevation of temperature.

A Consideration, with Analysis, of Certain Causative Factors Likely to Result in Shock.

Railway injuries, as will be seen, include every form of wounds as at present classified. The causative factors producing these injuries vary from the mildest form of force capable of producing wounds to the most intense and profound form of kinetic energy, as represented in mass, velocity, and gravity. A review of these causative factors in railway injuries, as tabulated in a preceding chapter, demonstrates the extreme diversity and the varying play of forces arrayed against the physical and mental construction of man. Heretofore all authors, when describing the extreme intensity of conditions created in railway accidents, have cited collisions upon the railway as being the most potent of all causes in generating the most serious and lasting psychic effects.

Page says: "The incidents, indeed, of almost every railway collision are quite sufficient, even if no bodily injury is inflicted, to produce a very serious effect upon the mind, and to be the means of bringing about a state of collapse from fright, and from fright only. The suddenness of the accident, which comes without warning, or with a warning which only reveals the utter helplessness of the traveller; the loud noise, the hopeless confusion, the cries of those who are injured—these in themselves, and more especially if they occur at night or in the dark, are purely adequate to produce a profound impression upon the nervous system; and even if they cause no marked shock or collapse at the time, to induce a series of nervous disturbances at no distant date." Page quotes Furneau Jordean,[1] who says: "The principal feature in railway injuries is the combination of the psychical and corporeal elements in the causation of shock in such a manner that the former or psychical element is always present in its most intense and violent form. The incidents of a railway accident contribute to form a combination of the most terrible circumstances of which it is possible for the mind to conceive. The vastness of the destructive forces, the magnitude of the results, the imminent danger to the lives of numbers of human beings, and the hopelessness of escape from danger give rise to emotions which in themselves are quite sufficient to produce shock or death itself. All that the most powerful impression on the nervous system can effect is effected in a railway accident; and this is quite irrespective of the extent or importance of the bodily injury."

In view of the many assertions made about collisions, which are unsupported by truth and fact, it behooves a searcher after truth to use all the discernment and study possible in order that a correct interpretation may be made of all essential and leading elements entering into this subject. The experience of years has shown the writer that when a person applies to medical counsel for treatment, averring that he has been in a railroad collision, the medical attendant never for an instant seeks to determine the real, immediate, and controlling factors concerned in this collision. If it be a railway collision, the medical attendant straightway assumes that all the horrors and harrowing detail described by Page and Forneau Jordean have been manifested and surrounded this supposedly injured person. This course is unjust and reprehensible. It is plainly the duty of a just and discriminating medical attendant to strive to reach the truth. Hence, any medical attendant but imperfectly performs his honest duty, to a patient claiming to have been injured in a collision, if he fails to analyze every element entering into the manner of infliction, *i.e.*, influence of surroundings and the actual subversion of normal elements at the time of accident to the individual. The mere fact that a collision has occurred upon the railway does not necessarily imply that extreme and intense conditions have existed. In fact, the conditions so vividly described in the above quotations are now exceptions and very far from being the rule. When Page and Forneau Jordean described collisions, they were true, because at that time inferior mechanical appliances were used upon passenger trains, and constant telescoping of coaches added horrors and death to collisions in almost very instance. A truthful and unprejudiced observer or investigator would soon determine that the powerful and effective mechanical equipment at present used upon trains has a tendency to lessen the horrors and dangers of collision. The Westinghouse automatic air brake, the Miller platform, and vestibule coach attachments have made it possible for collision after collision of the head-end variety to occur without the passengers in the rear Pullman coaches even being aware of a collision occurring, and frequently very few passengers are even partially unseated. Hence, it is necessary for a correct diagnosis to consider collisions discriminatingly, and not assume that, because a person has been in a collision, psychic shock must have resulted.

---

[1] "Surgical Enquiries," second edition, p. 37.

The location of a passenger on a derailed train has an influence, positive and pronounced. If the passenger is in a coach near the colliding forces, the greater the amount of force manifest, and the greater the disturbance of surroundings, the more likelihood of extreme fright and psychic shock. Tail-end collisions are, as a general thing, not so severe as the head-end collisions, but, of course, everything depends upon the suddenness of occurrence, the horrifying conditions present, and an inability to use protective measures.

As will be seen in the tabulated list, there were 2,354 persons injured in collisions, and in 165 of these the injuries were fatal. Of these, there were 1,266 employees injured, with 80 fatalities; 949 passengers injured, with 54 fatalities; 139 citizens, with 31 fatalities.

As a general thing railway derailments arising from defective road-beds, broken rails, defective equipment, washing away and breaking down of bridges, have many of the intense elements which collisions possess. The intensity of conditions depends upon the rate of speed, physical surroundings, as where derailments occur upon embankments and deep cuts, and a consequent tumbling of coaches down embankments. Derailments are not so fruitful in death and psychic shock generally as collisions. Thus, there were 2,351 injuries from derailments, with 115 deaths; out of this number 891 were passengers, with 13 fatalities arising therefrom. Now, in collisions we generally have more fatal accidents than we do from derailment. There were 1,357 employees injured by derailment, with 77 deaths; 203 trespassers, with 25 deaths. The most fatal of all injuries occurring upon the railway is falling from trains while in motion; there were 2,589 injuries occurring from this source, and 228 fatalities. Out of this number 2,269 were employees, 176 trespassers, with 35 deaths; 121 passengers, with 19 deaths.

As will be seen above, out of 949 passengers injured in collisions, 54 died; out of 891 injuries in derailments, there were 13 deaths; while of 121 passengers falling from trains in motion, 19 died, or 1 passenger in 6.36 was killed. Thus showing the last named to be the most fatal form of accident to passengers.

WHY RAILWAY INJURIES ARE CONSIDERED SPECIALLY.

It is generally admitted that there are no dividing lines between the surgery of traumatism in general and the traumatisms occurring upon the railway, yet a special study of the latter is demanded in order that a more detailed history may be given, and that all modifying elements entering into the infliction, course, and termination be more justly determined, properly tabulated, and placed under correct headings.

As indicated in a preivous chapter, the general causes and specific agents of railway injuries are given. All necessary data have been accumulated from injuries occurring entirely upon the railway. It is to be hoped that in consequence of the experience and careful study gleaned in this special direction, the writer may be enabled intelligently to consider many questions of importance and interest.

A special study of any subject naturally creates knowledge and familiarity of detail not gleaned by a general and cursory examination. This detail inherently constitutes the life of the subject, since it is only by a close investigation of minutiæ that the real depth, breadth, and true comprehension of a subject are reached. It is pre-eminently true of railway injuries, as it is of injuries arising from any other source, that a correct diagnosis is of paramount importance. The correctness of diagnosis in any form of injury must depend upon a general consideration of every element entering into the manner of infliction, the conditions under which the injury was inflicted, the general surroundings, as well as their influence upon the injured persons. As just stated, this not only includes the manner of infliction, but a proper conception of the quality and character of force used in the infliction of an injury. To do this, there must be upon the part of the surgical attendant a full knowledge of the peculiarity and the quantity of force of the inflicting agent. It will be found that a proper study of the relative capacity of the inflicting agent or agents, along with the surrounding elements at the time of infliction, are immediate and forceful factors in their capacity to beget physical and psychic effects. There should also be an ability properly to estimate and compute the comparative effects of an injury when inflicted in mild-factored rest.

An analysis of the cause in many accidents will indicate that force is the agent which rules the action of the injured individual without regulating the will, a subconscious, immediate, and instinctive effort aiming at protection. Injuries occurring under these conditions are among the most fateful, frequently abounding in psychic effects. Natural predisposition existing in the injured individual often indicates the quantitative and qualitative effects of an injury, which are not always proportionate to the gravity of the injury, nor to the intensity of attendant circumstances at the time of infliction, nor yet dependent upon the manner of infliction. The social status of injured persons should be especially studied, particularly whether the injured person be married or single, a passenger, citizen, or employee. If passenger and citizen, is it possible to elicit in the examination of the case the presence of a financial element, social worries, or baneful influences of habits? If an employee, does he belong to a protective insurance or not? for experience indicates that, when an employee with large family is uninsured and severely injured, whereby the likelihood of permanent disability is manifest, mental worry incident to the employee's social state and future condition becomes a positive influencing factor in the result.

As we have constantly indicated, a proper study of the inflicting agent, the manner of infliction, the parts exposed to injury, is necessary, as all are of marked importance. No single factor in diagnosis and prognosis in railway injuries has greater importance than a close study of the force governing the inflicting agent. It is equally important that the surgeon should at all times in the examination of railway injuries aim justly to compute and comprehend the full force, peculiarity, and power of injuries inflicted while the injured person is passing from a passive to a kinetic condition, and *vice versa*. This holds pre-eminently true in certain joint injuries. There is an immense difference in the effect and result on a joint injured by a person falling from a train in motion and falling from a standing train. An examination rarely discloses any physical difference in appearance between these injuries. In fact, no difference can be seen when the person is put under an x-ray examination; but when a person falls off a moving train, owing to the transfer of force, there will be of necessity greater injury to the joints affected than to joints injured under the milder conditions of falling off a standing train. The prognosis in the first instance is never favorable for a complete recovery, since the contusion of the joint surfaces and tissues in the immediate vicinity is always excessive. Where distance, momentum, and rapidity are present, a permanently injured joint almost always results from injury inflicted under the kinetic conditions mentioned.

Again, it is certain that there is a great difference between falling from a moving train and jumping from one. In the latter instance the inherent mental and muscular alertness and protective adaptation are generally powerful factors in preventing serious trouble, if no other complication arises. Injuries arising from falling from moving trains depend for their severity upon several factors: first, the rapidity of the kinetic agent at the time of infliction; secondly, the falling on some movable or insecure element. Many compound fractures arising under these conditions, when distance and excessive rapidity are manifest, frequently cause the broken bones to protrude through broken skin, and then force their way into the ground, boards, and other elements. The forceful shock to the parts seems to beget conditions trophical in nature. Certain it is that normal repair is very slow, and at times persistent results are evident. Here resection of denuded bone surface does not always aid in the healing process, so that at times amputation has to be resorted to. Cases now and then occur where the extreme concussive force leads to brain and cord trouble. If the force is sufficiently severe, it may produce fracture at the base of the skull or extensive concussion of brain substance.

Back Injuries.

Probably no part of the human body is so constantly involved in railway injuries as the back. The back includes the posterior part of the trunk extending from the last cervical vertebra to the last lumbar vertebra, its superior boundary extending laterally from the body of the first dorsal vertebra to the posterior part of each acromio-clavicular articulation, its lateral boundaries being lines drawn vertically downward from the posterior part of each acromio-clavicular articulation, extending to the crest of ilium on either side; its inferior boundary being a line extending across the middle of the last lumbar vertebra, meeting the lateral lines (extending down from posterior part of the acromio-clavicular articulations) at the crest of the ilium or brim of the pelvis. Although this area includes the loins, which extend from the last dorsal vertebra to the brim of the pelvis, we will include this region within the arbitrary boundary thus established in describing back injuries in order that we may more completely particularize in connection with these injuries. Any injury occurring in the cervical region will be so designated. The general descriptions of back injuries are, as a rule, rather loosely drawn. The back, then, is defined as a large space composed of skin, with back furrow, caused by the prominence of the erector spinæ muscles on each side, which runs down the middle. The spines of the vertebræ are made manifest by a little friction with the fingers down the backbone, which causes the spines of the vertebræ to be tipped with red, so that they can be easily counted and any deviation from the straight line detected. It is worth remembering that the spine of the third dorsal vertebra is on a level with the commencement of the spine of the scapula; the spine of the seventh dorsal is on a level with the inferior angle of the scapula, and that the spine of the last dorsal is on a level with the head of the last rib. On the back there are five layers of muscles. The first layer is composed of two large muscles; the second layer, of three muscles; the third layer, of four muscles; the fourth layer, of five muscles; and the fifth layer, of twelve muscles; fifty-two in all, exclusive of the six muscles in the cervical region. The first layer is supplied by the following nerves: the spinal accessory, anterior division of the third and fourth cervical, and the long subscapularis nerve; the second layer of muscles is supplied by the anterior branches of the third, fourth, and fifth cervical nerves. The fourth layer of muscles is supplied by the posterior divisions of the cervical nerves and the posterior divisions of the lower dorsal nerves. The fourth layer is supplied by the external branches of the posterior divisions of the lumbar and dorsal nerves. The fifth layer of muscles is supplied by the posterior divisions of the dorsal and lumbar nerves. Along with this, there are innumerable muscular connections and tendinous attachments of the fifty-two muscles, besides a bountiful supply of blood-vessels.

In addition, there are the vertebræ attached to each other, and the ribs attached to the vertebræ. The union of the various segments of the vertebral column forms the vertebral canal. This has meninges which are attached to the inner side of the canal and spinal cord, its membranes and different nerve distributions. From this rough description it will be seen that the back is an area composed of a multiplicity of parts, all of which are subject to injury, and many of them are made manifest by pain in the back. Hence, it is just to assume that there can be a multitude of causes for back pain arising from back injuries. Naturally, then, back injuries offer an unusually large field for differential diagnosis. Prior to entering into the consideration of back injuries, the writer appends a list of back injuries, and as a matter of convenience and condensation it will include injuries to the vertebral column, *i.e.*, its fractures and dislocations. Thus, in 82,361 railway injuries tabulated by the writer, 4,566 were back injuries divided as follows: Muscular sprains numbered 3,782; contusions, 365; lacerations, 66; incised wounds, 20; punctured wounds, 16; gunshot wounds, 9; burns and scalds, 20; so-called concussion of the spine, 128; dislocations, 4; fractures of the vertebral column, 28; and so-called traumatic lumbago, 51.

The general definition of sprain cannot be justly applied to many muscular injuries involving the back, since authority confines this word to involvement of joints. Thus a sprain "is a condition of pain, swelling, etc., produced in the soft parts about a joint, by violent wrenching or straining of them without dislocation of the articular surfaces; also, the lameness that follows."[1] In a considerable number of back injuries, the intervertebral joints are in no manner involved, but muscular fibres or tendinous attachments are ruptured, when blows on the back are received, particularly while the muscle is in a state of contraction, by falling on the back and striking various substances competent to produce deep contusions. The writer believes that any force sufficient to involve the articulation of the vertebræ will not only cause muscular-fibre rupture but possibly injure intramedullary elements. Therefore the action or effect of strain is to bring to bear on a structure an amount of force sufficient to endanger or impair its integrity. The great bulk of muscular back injuries are of this class.

LUMBAR SPRAINS AND STRAINS AND SO-CALLED TRAUMATIC LUMBAGO.

No portion of the body of railway employees is so exposed to the combined effects of illness and injury as the lumbar region, and this is particularly so with the locomotive fireman, who stands before a superheated boiler-head and open fire-box, shovelling coal into the furnace, with back bent, the perspiration pouring down the furrows of the back and accumulating on the lumbar region. His underclothing becomes saturated with perspiration, forms a wet pack over his loins, while a constant and excessive draught of cool or cold air passes through the gangway (the space between the engine and tender) directly over the small of his back. Hence, here is a condition which constantly courts the occurrence of lumbago, which is very frequent, not alone with firemen, but also with many other railway employees. Rheumatic affections of the sheaths of the lumbar muscles on one or both sides, extending often to the ligaments of the sacrum, are frequent. It will thus be seen that these conditions also predispose to rheumatic inflammation of the lumbar region. Essentially the same symptoms are manifested in lumbago as are found in lumbar sprains and strains, and as a general thing muscular sprains connected with the lower dorsal region manifest excessive pain in the lumbar region. While admitting that rheumatic affections follow injuries to the lumbar region, we cannot conceive that this occurrence is in any manner sufficiently frequent to be of importance. Consequently, all lumbar sprains are at times loosely classified when considered as traumatic lumbago. As a matter of fact, so-called traumatic lumbagoes constitute a very small part of the injuries to the muscles of the back. We cannot believe that it would make much difference, either in diagnosis or treatment, if some cases should be erroneously considered to be traumatic lumbago.

---

[1] Foster's "Encyclopedic Medical Dictionary". D. Appleton & Co., New York, 1893.

SPRAINS, STRAINS, AND MUSCULAR-FIBRE RUPTURES OF THE BACK.

Muscular sprains and strains of the back, as already indicated, are of very common occurrence, and their causes are numerous. Thus they result from collisions, derailments, falling or jumping from moving trains, being struck by trains, falling from bridges and trestles, jumping on moving trains, falling into pits, etc.

To illustrate: Under the heading of "falling from trains," standing trains, etc., 3,173 injuries occurred to employees, with

205 fatalities; 433 to citizens and trespassers, with 72 fatalities; and 285 to passengers, with 22 fatalities.

Heretofore all authorities have taken collision as a typical manner of infliction for back sprains and strains, owing to the fact that the surroundings were productive of psychic shock as well, yet, while it is true that back sprains and strains are produced in the ways above mentioned, they are produced in many other ways and by other conditions. They are frequent in collisions and derailments where trains in excessive kinetic energy are brought to a sudden and demoralizing stop without warning to the individual, whose muscles are at rest and relaxed, and who is unable to make a single protective effort. Powerful forces throw the individual backward and forward, or in a variety of ways, forcibly flexing, extending, wrenching, and twisting the muscles, tendons, and their attachments, producing excessive muscular pain of the back muscles, and at times rupturing muscular fibres of the superficial muscles, and when intense enough even involving the articulation of the vertebral column.

Regions Involved in Back Injuries.

The lumbar region seems to be more frequently affected than all other portions of the back combined. This is due to its great range of function, its flexibility, its multiplicity of muscles and muscular attachments, the wide range of motion it allows, along with the effect of the superincumbent weight above, which it bears. The next most frequent injuries are to the cervico-dorsal region, which are likewise caused by the extreme flexibility of the parts composing it. Then come injuries to the whole back, and last of all injuries of the dorsal region, which rarely take place without fracture or dislocation of the vertebræ, with consequent compression lesions. Hamilton[1] says "there are few cases of severe railway injuries in which sprains are not found." Dana goes so far as to say "that traumatic neurasthenia is nothing but ordinary neurasthenia with added sprain," so important does he consider this result of the ordinary expenditure of violence to be. Sprain is mentioned in most treatises as a constant symptom of traumatic neurasthenia, which, however, it is not. A careful study of back sprains and strains will certainly indicate that the severity of symptoms is generally proportionate to the severity of force involved in their production, and any excessively abnormal manifestations arising from trivial injuries can be explained only by some inherent predisposition which causes these violent manifestations. Experience indicates that the severity of symptoms is shown by plain pathological evidences of the parts involved. Any force of sufficient intensity to involve the spinal column is always fraught with more or less danger. Generally superficial strains indicate the parts involved, and their history always shows that intense elements were lacking in the manner of their infliction.

---

[1] "Railway and Other Accidents," by Allan McLane Hamilton. William Wood & Co., New York, 1904.

When a force has been severe enough to tear the ligaments connecting the vertebræ, the rupture of the ligamenta subflava with their bountiful supply of blood generally produces an immediate and severe extradural hemorrhage, which by its pressure develops a temporary paraplegia, with a possibility of the development of a meningitis or a myelitis. Again, in some alleged back sprains, the subsequent history may indicate conditions which do not owe their origin to the immediate effect of trauma. Thus, after a wreck, either collision or derailment, which has taken place upon a cold day, and between stations, passengers are compelled to leave highly heated cars and await relief, which may not come for several hours. Passengers thus exposed to the rigors of the weather, and perhaps too lightly clothed, often walk excessively and exercise much more than they are accustomed. Hence such an exposed person may suffer from rheumatic lumbago, as well as other inflammations. Should such a passenger contract lumbago, it would be hard to convince many medical attendants as to its true origin, but it would most probably be considered to be an element of traumatic psycho-neurosis, and not an acquired trouble.

Symptoms of Lumbar Sprain and Strain.

Symptoms of lumbar sprain and strain may not develop until several days after the accident, or they may be evident several hours thereafter, seemingly in proportion to the severity of muscular strain, and whether one or both sides are involved, it being generally found that, where both sides are involved, greater symptoms of pain are present along with lessened ability to move. Evidences of injury are pains in the small of back, a general stiffness or rigid condition of the back extending across the loins. The pain may be at first dull and aching and continuous during any use of the muscles. Muscular movement excites an intense darting pain beginning in the small of the back and at times extending down the limbs and up in the upper lumbar and most of the dorsal region. It is an agonizing pain, allied to the pain of an inflamed nerve, muscle, or muscular sheath, or pains such as are produced by inflammation in certain low forms of tissue. In cases where great violence is manifested, as when both sides are involved, the stiffness presents itself in a thoroughly rigid condition of the muscles, and the back is held in a fixed position, partly from fear of motion producing pain, and possibly at times reflex where slight contusion has been inflicted upon the nerves in their exit from their foramina. Along with this condition there is a difficulty in micturating and voidance of fæces, plainly owing to the constant fear of contraction of the lumbar muscles in these acts, and its consequent production of pain. Finally, a mental condition develops which harasses the patient, *i.e.*, dread of ultimate serious consequences. The apprehensive, nervous patient frequently imagines that he is paralyzed, or is becoming so. This assertion, or its equivalent, has been made to the writer, not once, but many times, suggested from the palpable conditions which present themselves, namely, the sense of weakness, the constant pain on motion, the stiffness of the back, the utter inability to walk, except at a laggard's pace, with excruciating agony at every step, and the inability to attend to the wants of nature, leading at times to the retention of urine, with consequent dribbling, and withal, there is the mental tension incident to loss of rest and more or less constant pain.

The following case presents most of the elements which attend a severe case of lumbar sprain:

G. S., a passenger on train and in Pullman car, age 32, muscular and well developed, intelligent and unusually observant. He states that while standing in the aisle of the car, to avoid a collision, the automatic car brakes were applied to the train, suddenly stopping it. G. S., as he expressed himself, "simply reversed ends." He claims that he was thrown around the "periphery of a circle," alighting on right shoulder and arm. He was somewhat "dazed" to use his own expression, but immediately after the accident he "picked himself up." Not feeling hurt, he walked to the car platform to see how near the train had come to colliding. He continued his journey. Pain in the small of his back slight, said he felt pain in the shoulder more than he did in the back. On the fourth day afterward stiffness of the back became pronounced. He was seen upon the evening of the fourth day after the accident, and presented all the evidences of severe lumbar sprain. At the patient's urgent request the examination was mainly colloquial. There was a slight increase of temperature, but no other systemic effects aside from sprain were apparent. The patient thus described his own feelings: "I have a mixed feeling of weight and weakness. I feel like I imagine old Atlas must have felt when he carried the world, weighted, weak, and tottering. I can't move, for when I do a stabbing, sickening, breath-robbing pain runs up and down my legs and back. I can't do anything in bed; when I get up I am bent forward, my legs straddle and seem bowed. Last night when I was in bed a series of cutting pains extended in every direction from the middle of my back, and made my life miserable until I got warmed up. My mind is in constant tension from trying to dodge pain. A turtle is not more circumscribed to his shell than I am to my painless territory."

Strains and Lacerations of Tendons of Back and Cervical Region.

Among tabulated lists of back injuries already mentioned, there are 365 contusions of the back, 66 lacerations, and 36 crushes of the body involving the back more or less. Rupture of muscular fibres may take place where injured individuals have back bent, or are struck upon the back by some sharp-cornered or blunt surface, as the falling of lumber, castings, and other things, or struck by the end of a car, or when carrying heavy weights, or falling on back and striking some projecting element. There are, in many instances where the deeper layer of the muscles ruptures, no external signs of injury, but as a general thing contusions of the back are manifested by swelling and ecchymosis, and not infrequently hæmatomata are present. In severe contusions of the back, at times symptoms occur which more or less closely resemble those present in violent lumbar sprains. Extensive hæmatomata are often complications, but they generally yield to pressure and the expectant plan of treatment; at times they may terminate in abscess. In muscular-fibre rupture of the back, where we find persistent and fixed pain at any given point or area, we are led to believe that an inflammatory process exists. Again, when we find fixed and persistent pain in connection with osseous points of the vertebræ, it indicates the possibility of the rupture of muscular ligaments and tendinous attachments. The writer has seen in two different instances partial rupture of the erector spinæ and latissimus dorsi muscles. In one instance it extended from the first lumbar vertebra diagonally downward almost to the middle of the crest of the ilium; in this case the injured individual fell from a trestle, striking on his back across a piece of lumber. The crease where the muscles had been ruptured subcutaneously was plainly manifest, and persisted as a depression after the patient got well. The other instance, in which the injured individual had been struck upon the back by a moving car, the injury was higher up. This individual also had fractures of the ribs. In the first instance a contused wound was present, and, as before stated, the depression was marked. At the end of the third month there was little difficulty in bending the back. As a general thing contusions and lacerations of the back disclose the extent of muscular rupture and are plainly evident lesions, but now and then violent blows on the back inflicted in a variety of ways are followed by temporary paraplegia, which we believe cannot be attributed to any concussion of the cord, but to a palpable lesion of the cord or its membranes, such as hæmatomyelia and hemorrhages of the membranes; but extramedullary hemorrhage, occurring as a distinct lesion without injury to the cord, is at all times to be doubted. The writer does not believe that it can occur. Again, owing to the extreme flexibility of the cervical region, muscles of this region are exposed unduly to rupture, involving the trapezii and probably at times the scaleni.

G. D., an engineer, age 38, a native, and married, while in transit, seeing an approaching train, and knowing that collision was inevitable, applied air and tried to jump from engine; but caught foot on iron apron between engine and tender, fell backward off the engine, a distance of ten or twelve feet, struck on back of neck and shoulders. A severe contusion was present on upper portion of shoulders, slight cutaneous wound on upper dorsal region of back, along with swelling extending up and into the cervical region, excessive contraction of the neck muscles, trapezii, and possibly scaleni muscles are affected; head drawn back and neck seemingly shortened, as though pushed downward between the shoulders; slight separation between the fifth and sixth cervical vertebræ, as though the *ligamentum nuchæ* were involved;

complains of extreme pain at base of skull, unable to rotate head; symptoms gradually increased, but after the second week he was able to walk about the ward, muscles still contracted, cannot turn neck; no effort was made at flexion. He gradually improved and by the second month could flex the neck partially, but could not rotate it freely. Patient believes that his neck is shorter than it ought to be.

L. R., age 30, fireman, single, native, injured Dec. 17th, one year, side rod of engine broke, engine stripped herself, that is, the broken side rods revolving with the driver, knocked engine cab off. While endeavoring to get off the engine to avoid being scalded by escaping steam, engine lurched, and he fell backward, alighting on back of neck and shoulders. Brought to hospital twelve hours after injury. Contused wound of occipital region, muscles of the neck excessively contracted; complains of muscular spasms and twitching and excessive dizziness, neck held in contracted position, will not bear pain of examination, evident involvement of trapezii and scaleni muscles. Symptoms gradually improved and at the end of the sixth week had so improved that flexion of neck gave but little pain, but could only imperfectly rotate head or neck. Returned to work at the end of the second month with impaired rotation and a tendency to "cricks in the neck," as the patient expressed it, occurring once in a while.

The writer has recorded a number of similar cases. As a general thing these cases develop their characteristic symptoms almost immediately, some an hour or so after the injury. While all painful symptoms may disappear, yet there generally remains more or less impairment of function for a month, a year, or permanently, particularly as to rotation.

SO-CALLED CONCUSSION OF SPINAL CORD.

The majority of present writers deny the possibility of such a thing as concussion of the spinal cord; that concussion can produce a temporary paralysis of the spinal cord from simply molecular vibration without lesion has not been demonstrated. A careful study of the anatomical surroundings of the spinal cord, its substantial and compact encompassment, certainly indicates that the serviceable and powerful construction of all its parts makes it difficult to injure, and it certainly is not likely to sustain midway functional derangement. Plain and evident symptoms are, in the writer's opinion, generally due to palpable lesion; any one treating railway injuries will soon come to the conclusion that direct and competent force will rarely, if ever, produce trivial results. When one sees in railway accidents force applied, seemingly competent to break hard material substances, producing no impression upon the individual when his protective powers are at their best, cannot fail to admire the wonderful resistive powers of the human body; but when injuries produce their symptoms, and these symptoms are evident and definite, we know that they cannot come from any shadowy force, but an absolute positive force, which begets absolute lesions. It is now demonstrated that a number of conditions attributed to concussion are secondary processes dependent upon lesions in and about the cord. It is undeniable that hemorrhages within the cord or in connection with the membranes may occur and be followed by rapid disappearance of symptoms, formerly claimed as being characteristic and consequent upon concussion, but never demonstrated.

It is not essential at this time to show the great breadth of trauma as a disease-producing agent; it is, however, pertinent to the subject to mention that trauma of the spinal cord covers almost the entire extent of cord symptoms; they are indefinite in number, not only as regards their great diversity and type, but equally so as relating to their generally various stages. All kinds of injuries to the cord are at times competent to produce myelitis, but this is a secondary process of trauma. The attempt upon the part of writers in the past to claim that localized concussion produced far more extensive myelitis than ordinarily occurred, certainly wrongly interprets the causes producing it, gross lesions of the cord having occurred previously. Gowers,[1] in speaking of the rapid onset of myelitis in some cases arising from trauma, says, "Such rapid onsets resemble that of spinal hemorrhages, in addition to inflammation." Certain it is that the diagnostic rule, that a sudden onset of symptoms after an injury plainly points to the occurrence of hemorrhage and lesions of the cord is correct, and the disappearance of symptoms merely indicates the absorption of the hemorrhage.

TRAUMATISMS OF THE VERTEBRAL COLUMN.

When the anatomical construction of the vertebral column is thoroughly studied, particularly its individual segments, their connections and relations, and multiplicity of elements, it can

---

[1] "A Manual of Diseases of the Nervous System," by W. R. Gowers, M.D., London.

be readily seen and understood that injuries to these segments can give rise to many pathological conditions. It requires more than ordinary care properly to interpret these conditions when they arise; any injury involving the integrity of the vertebral column menaces not only the part locally affected, but oftentimes the whole economy of the injured individual. In both fractures and dislocations of the vertebral column, the first question which must of necessity arise is whether the fracture or dislocation has caused injury to the spinal cord. If the cord is involved it is necessary to determine what segments are affected; and whether the cord has been primarily crushed, or is pressed upon by bone, blood, or exudates. While the possibility of uncomplicated dislocations of the vertebral column has been demonstrated by post-mortem, yet it is an established fact that these dislocations are of unusual infrequency. We know that fractures of isolated segments of the vertebral column may take place without any great amount of displacement, and without interference with the lumen of the canal or with the cord. Henle's[1] classification of vertebral-column injuries, in the writer's estimation, is the best that has been presented, consequently it will be here followed in describing vertebral-column injuries. He divides them into partial injuries which include:

(1) Distortion and (2) single dislocation of the lateral joint; (3) contusion and (4) isolated fractures of the vertebral column (pressure fracture); (5) isolated fractures of the arches and spinous processes. Next complete dislocation with fracture; (6) complete dislocation (of the lateral joints and displacements in the region of the intervertebral disk); (7) dislocations with fractures due to pressure dislocation of one or both lateral joints and pressure fracture of the body; (8) complete dislocation with fracture; dislocations with diagonal fractures (dislocations of the lateral joint and dislocations in the region of the fractured vertebræ).

Distortion and dislocation may be associated with more or less displacement of the vertebræ; they are not found independently in all regions of the vertebral column. Owing to the extreme freedom enjoyed by the cervical region, it is affected almost exclusively; now and then they may be in the lower dorsal and lumbar regions.

---

[1] Henle in Bergmann's "Surgery," p. 667, vol. ii.

DISTORTIONS OF THE VERTEBRAL ARTICULATIONS.

The most frequent cause of this injury is a fall upon the head, followed by forced extension or flexion. It likewise can be produced by a blow upon the neck; it is rarely caused by muscular action. Several neighboring vertebræ may be affected. When extension is accompanied with torsion, unilateral distortion occurs. The fourth, fifth, and sixth cervical vertebræ are the most frequently affected by distortion. Pain is present in the region affected, and any motion causes pain, or pain may be caused by pressure on the head. Patient keeps head and neck stiff with unilateral injuries. The face is turned toward the uninjured side, and the ear held toward the shoulder.

ISOLATED DISLOCATIONS OF THE LATERAL JOINTS.

The intervertebral disk may be torn or displaced in unilateral dislocations, but in isolated dislocations it remains intact. At times the posterior ligaments, particularly the interspinous ligaments, may tear, or be completely divided; the capsule often is divided transversely. Unilateral dislocations occur from excessive rotation and are called rotation dislocations. Rotation and abduction are produced only by unilateral dislocation, while flexion is manifest in bilateral dislocation. In unilateral dislocation the joints of both sides suffer; the dislocated joint is subject to more or less distortion.

UNILATERAL DISLOCATIONS OF THE LATERAL JOINTS.

These dislocations have been termed "rotation dislocations," "abduction dislocations," and "flexion dislocations." Henle maintains[1] that the term "flexion dislocations" should be used only for bilateral dislocations, because flexion is the essential cause. "Rotation dislocation" may be caused by direct violence or falling backward on the head, and rolling over, particularly as in falling from the tail-board of a wagon. Excessive muscular action may be followed by rotation dislocation. Symptoms in unilateral displacement vary according as there is a dislocation or a subluxation. In dislocation the head is bent to the affected side, while in subluxation the head is bent to the unaffected side.

Deflection of the spinous processes toward the affected side gives evidence of rotation. Prominence of the transverse process of the injured side, and the corresponding half of the body of the vertebra, is more in evidence in dislocation. When the lower cervical vertebræ are dislocated, flexion is compensated by lordosis. According to Henle, Kocher is of the opinion that flexion takes place always toward the diseased side. Inspection enables the demonstration of deviation only in the spinous processes of the three lower cervical vertebræ; the spinous processes of the other cervical vertebræ are rendered unapparent by the muscles and the ligamentum nuchæ. Hence palpation must be used to ascertain deviations in other cervical vertebræ, or be detected by the *x*-rays. There is more pain in distortion than in dislocation. It is not an unusual thing to have the subluxated side more painful than the dislocated side. There is also pain in the region of the dislocated joint. The spinous processes are also painful under pressue. Again, pain is produced when pressing upon the head. Cord symptoms with rotation dislocation are not usually severe, and at times are absent. Now and then, in severe cases, hæmatomyelia follows to a greater or less degree in rotation dislocation. The essential difference between dislocation and subluxation is that in all subluxations movements are possible with pain, while in dislocations certain movements are impossible, and they give comparatively little pain.

---

[1] *Loc. cit.*

CONTUSIONS OF THE VERTEBRAL COLUMN.

Contusions of the vertebral column have varying degrees of effects, depending upon the amount of force engendering their infliction, their locality, and character. Contusions of the spinal column are competent to produce a long list of troubles; among them are hemorrhages of the cord, both intra- and extra-dural, fractures of the body and processes of the vertebræ, dislocations, meningitis, myelitis, and spondylitis traumatica. Contusions of the spine acting in the long axis of the column, as in falling upon the feet, buttocks, or the falling of a weight upon the head, cause incomplete fractures of certain segments of the column. As a general thing isolated fractures of the body of the vertebræ are always contusion or pressure fractures. The vertebral contusion, or pressure fracture, is most common in the dorsal region and upper lumbar region. The most frequently involved vertebræ are the last two or three dorsal and the first lumbar, while the upper third of the dorsal and lower lumbar are the least affected. According to Henle, Kocher found that out of twenty-three isolated fractures of the bodies the eighth and twelfth dorsal vertebræ were affected eleven times, the lumbar seven times, the twelfth dorsal and first lumbar were involved five times. Four of the twenty-three fractures were in the upper third of the dorsal region. There exists extreme flexibility in the cervical region, and pressure fractures there are rare. Kocher calls attention to the fact that where the spine has little power of flexion fractures are most common. The principal symptoms of pressure fracture are antero-posterior deformity and prominence of the spinous processes. Angular deformity may disappear when the patient lies down, and reappear when an erect position is assumed.

ISOLATED FRACTURES OF THE ARCHES.

Spinous Processes and Transverse Processes.—Isolated fractures of the spinous processes are more frequent in the dorsal region; now and then other portions of the column are liable to be affected. One or more vertebræ may be injured; crepitus, abnormal mobility, along with swelling and blood effusions, are the main symptoms. Displacement is rare. Fractures of the vertebral arch are of more importance than fractures of the spinous processes, owing to the likelihood of the spinal cord being affected. Fractures of the arch are more frequent in the cervical region than the other regions; the atlas and axis being the points of election. When the arches of these two vertebræ are broken transversely, death ensues rapidly owing to severe injury to the cord. When no cord symptoms exist, recovery is uneventful.

COMPLETE DISLOCATION WITH FRACTURE.

In complete dislocation with fractures the continuity of both anterior column and the articular columns is interrupted. The bodies of the vertebræ constantly suffer, while fractures of the strong articular processes are infrequent. A slight dislocation may be accompanied with a compression fracture, or a marked diagonal fracture with marked dislocation. Complete dislocation always affects the lateral joint and the disk between the joints. In proportion to the completeness of the dislocation does displacement of the segments take place and the consequent destruction of the cord. Complete dislocations are confined to the cervical portion of the column. The first and second dorsal vertebræ are the favorite seats of dislocation with diagonal fractures. These fractures occur now and then in the lower cervical region as well. Dislocation pressure fracture and isolated compression fracture occur in the lower dorsal and lumbar regions. When these exist, symptoms of complete destruction of the cord are manifest, and it is proper and natural to expect complete dislocation. In transverse lesions it is almost impossible to tell the exact extent of injury inflicted upon the cord. As stated in the beginning of this article, the first and most important element for diagnosis is to examine whether the spinal cord is injured. Taking into consideration the number, extent, and complication of spinal-column injuries, it is not at all an easy matter to make a proper differential diagnosis. It is at times extremely difficult to tell whether the injury to the cord is a complete transverse destruction or a partial transverse injury. As before stated, in complete transverse cord lesions the reflexes are absent and accompanied with paraplegia. The motor paralysis is almost completely symmetrical; this, with the fact that sensory paralysis and motor disturbances indicate injury to the same segment of cord, and are accompanied with cystitis, shows that bladder and rectum are paralyzed. While in partial lesions there is persistence or reappearance of the tendon reflexes, there is also lack of parallelism between motor and sensory paralysis. Paraplegia is incomplete, lacks symmetry. Symptoms fluctuate, or are very slow in their appearance. Isolated dislocations of one of the lateral joints, distortion and fracture of the spinous processes or arches, all present characteristic symptoms. Again, various injuries are peculiar to different sections of the vertebral column.

Complete Dislocation with Fracture of the Vertebral Column, with Consequent Spinal-Cord Lesions, Especially Complete Transverse Destruction.

It can be stated with truth that in no realm of traumatism are there any more acutely powerful, ponderous, and rapidly active definite agents than those which constantly exist in the field of railway accidents. Hence, in those injuriês in which power, ponderosity, and velocity of infliction are constantly acting, every stage of effect is observable. In analyzing the consequent factors of many railway injuries the investigator's interest is more than ordinarily aroused when he studies the causes, effects, and results of complete dislocation with column fractures. In every instance when analyzing the manner of infliction of these injuries, competent power, weight, and momentum are plainly and definitely established. The overturning of cars and coaches and engines upon the exposed persons is always competent to crush, fracture, and dislocate the vertebral column. Injuries to backs of engineers and firemen, from being struck by broken side-rods, weighing hundreds of pounds, and revolving in a circle with great speed, being hit in the back by fast-running cars or engines, falling on back from bridges, trestles, and telegraph poles, etc., while on running trains, struck by flying missiles, as in boiler explosions, all suggest an extreme degree of power and force sufficient to produce almost any character of injury. Hence in railway injuries where we have complete dislocations with fracture of the vertebral column, they are almost invariably fatal, and laminectomies only serve to show how complete is the solution of continuity of the cord, or to hasten myelitis or meningitis to a rapidly fatal termination. Spinal-cord injuries arising from railway accidents are almost invariably complete transverse lesions; partial solutions of continuity of the cord are extremely infrequent. The writer has never been able to substantiate Thorburn's[1] assertion that, in cases of injury to the cervical region of the spinal cord, recoil from injury is far more frequent than persistent displacement, and that their relative proportion is as two to one. He claims that cases of crushing injuries of the spine and spinal column which are followed by a recoil of the vertebra are generally fatal. The *x*-ray does not demonstrate recoil injuries; it is either dislocation, fracture of the vertebra, or hæmatomyelia. Contusions of the cord are secondary to fractures or dislocations of the vertebral column, the segments of which, being dislocated, squeeze and compress the cord. At the time of injury the cord may preserve its shape, though its nerve elements suffer. Any injury decreasing the lumen of the vertebral canal is prone to cause cord compression, as in displaced fragments of bone arising from dislocated fractures of vertebræ. Paralysis arising from partial solution of continuity of the spinal cord can completely disappear, owing to the fact that the unaffected part of the cord whose continuity is not affected assumes or takes on the function of the injured part. Henle[1] says: "The paralysis following unilateral lesions in the cord disappears as a rule. Experience shows that the healthy half of the cord undertakes the duties of the destroyed half (Turner, Rossolymo, Mott). Bruns does not believe this is possible, and holds that in cases in which the function was restored the corresponding nerve tracts were only compressed, and that the paralysis produced by destruction of nerve tracts is always permanent. If the power of conduction is definitely interrupted, secondary degeneration appears, usually in the efferent tracts (pyramidal tracts), away from the lesion (descending degeneration), and in the afferent tracts (Goll, Burdach), or cerebellar tracts and Gowers' tracts, above the lesion (ascending degeneration)."

---

[1] "A Contribution to the Surgery of the Spinal Cord," by Wm. Thorburn. Philadelphia, Blakiston, Son & Co.

After complete solution of continuity of the cord from transverse destruction no trace of conduction is found, either to or from the crushed area; complete anæsthesia is present with complete paraplegia. The paralysis is invariably flaccid, along with complete extinction of the tendon reflexes. Where the ganglion cells are not destroyed there will be slight atrophy, beyond that which is attributable to muscular disuse. There is no reaction of degenation. In complete solution of continuity of the cord, the vasomotor nerves being paralyzed, the internal organs may receive an insufficient supply of blood, because of which, along with disturbances of kidney nutrition, the quantity of urine voided may be very much less than normal. Again, in complete transverse lesions when vasomotor nerves are paralyzed, corresponding regions are warmer than is natural, while the subcutaneous veins are distended. The paraplegia existing in transverse lesions, especially in young males, is dependent upon the vasomotor paralysis. Kidney changes may be manifest and recognized by the abundance of dead epithelium.

The bladder and rectum in complete lesions are paralyzed and anæsthetic and retention of urine and cystitis constantly oc-

---

[1] Dr. A. Henle, in "System of Practical Surgery," by E. v. Bergmann. Lea Brothers & Co.

cur, undoubtedly favored by the vasomotor paralysis and too constant use of catheter. Owing to the paralysis of the compressive abdominal muscles, constipation is constantly present. Neglected flushing and cleanliness of the lower gut may lead to auto-intoxication, or this may arise in consequence of cystitis. In the opinion of Henle, retention of urine is due to reflex contraction of the sphincter of the bladder. The plexus found in the bladder wall may produce this condition when the spinal centres have been disturbed. Decubitus after complete transverse lesions may be severe, and trophic disturbances such as formation of bullæ are not so common. The lower the lesion the greater the prolongation of life. When complete transverse lesion of the cord affects the four upper segments, death is due to asphyxiation, owing to an interference with the phrenic and intercostal nerves. When the four lower cervical segments are affected, death takes place from arrest of respiration, by paralysis of the intercostals. In complete transverse lesions the reflexes are absent, there is paraplegia, and the motor paralysis is almost completely symmetrical. These manifestations, along with the occurrence of sensory paralysis and motor disturbance, indicating injury to the same segment of the cord, and accompanied with cystitis, showing that the bladder and rectum are paralyzed, give surety of complete transverse lesions. Partial transverse lesion is manifested by persistence or reappearance of the tendon reflexes. When there is lack of parallelism between motor and sensory paralysis, and the paraplegia is incomplete and lacks symmetry, and when symptoms at times fluctuate or are very slow in their appearance, it is safe to conclude that partial destruction of the spinal cord has occurred. Partial injuries are caused by fracture dislocations of the vertebræ and are remarkably infrequent in railway injuries.

E. D., colored section hand, age 20, native, single, brought in Sept. 28th, injured in the following manner. While standing on a car of loose dirt, handling a tool-box full of tools, weighing over 200 pounds, the dirt upon which he was standing, caved in and patient fell, the tool-box striking him on back of neck and shoulders. Examination reveals a young and well-nourished man; slight evidence of abrasion and contusion extending from the sixth cervical vertebra to second dorsal; vertebral prominence not conspicuous. Complete paralysis from seventh costal cartilages downward. Reflexes in lower extremities absent. Abdomen somewhat distended, muscles rigid and well defined. Marked tendency to paraplegia and acute rention, bowels constipated. Patient felt no pain while remaining quiet, but, on moving, complained of pain between the shoulders and marked stiffening of the neck, which persisted for ten days. Sept. 28th, temp. 102.5°. No change in area of paralysis, complete loss of sensation from eighth rib downward. Sept. 30th, temp. 103.5°, no change in area of paralysis, left pupil contracted, no movement of chest, breathing seems superficial. Oct. 1st, temp. 105°, patient taken to *x*-ray room, skiagraph showed displacement of second dorsal vertebra. Oct. 4th, temp. 105°, patient vomiting frequently, no change in area of paralysis. Oct. 5th, temp. 105°, pulse small and weak, and patient died at 10 P.M. Paralysis following immediately after injury. A plain case of transverse lesion. It is to be regretted that the form of death was not noticed, but from diminished chest breathing no doubt the intercostal muscles were involved. When the four lower segments of the cervical region are involved, they cause death from asphyxiation; and it is presumable that this patient died in that manner.

Dislocated spinal-column fractures, in the writer's experience, have been almost invariably fatal, indicating that there was transverse lesion with complete solution of continuity of the cord substance. But in complete dislocation with fracture of the vertebra there was only one instance where the patient lived. The manner of injury shows that severe force has been employed to occasion these injuries. Four fractures were produced by cars tumbling on the victim; three were side-rod fractures; four, by being struck by moving cars; two, by embankments caving in; three, by falling from cars or engines while in motion; one, by falling of a heavy tool-box on the back; one, by falling from a bridge. There were three cervical fractures, one first lumbar, the others dorsal fractures, the highest of which was the sixth dorsal; the remaining occurring between ninth and twelfth dorsals. Five laminectomies were performed, four of which were fatal and served only to show how complete were the solutions of continuity of the spinal cord, or to hasten myelitis or meningitis. The single case of transverse lesion due to fracture of the first lumbar vertebra is in many particulars unique and worthy of recording.

M. D., a passenger brakeman, single, age 32, native, in attempting to stick signal on end of train while in rapid transit, was thrown off rear end of train. He says he doubled up his legs as he was falling, and fell upon the upper part of the sacrum and buttocks. He became paralyzed at once, complete paraplegia and complete loss of sensation;

anæsthesia extended irregularly from the umbilicus down; bladder and rectum paralyzed; complete loss of tendon reflex, muscles of limbs flaccid, no priapism, unnatural warmth of abdomen and legs, decubitus manifest by the eighth day, and the most extensive the writer ever saw, extending from each sacro-iliac synchondrosis down to the coccyx; trophic disturbances manifest by characteristic bullæ. Bowels washed out regularly, bladder systematically attended to. The patient's paralysis did not extend. For nearly two years the decubitus was deep and extensive, healing process extremely halting and slow, bladder and rectum remain paralyzed, patient was compelled to wear a urinal constantly. Laminectomy had been frequently urged, but patient refused. He finally agreed at the end of the second year; laminectomy was accordingly performed, but progress of the patient was very slow; it was nearly two months before the decubitus began to heal, and at the end of nine months was almost completely healed. Bladder began to improve, but urinal not withdrawn. Paraplegia still persisted, the psoas and iliac muscles developed excessively. He is now able to turn himself in bed at will. The tensor vaginæ femoris appears active; sensation now extends downward from Poupart's ligaments; tendou reflexes absent; the amount of atrophy in the lower extremities is not excessive. It is now two years since the laminectomy and four years since the injury; the patient can get on his knees, but has no power to move limbs, except such as he would derive from the psoas muscles and the internal iliac; that is, an ability to move his legs by flexing paralyzed limbs on pelvis. Patient is usually well nourished; muscles still flaccid. At no time since his injury has there been a return of any of the tendon reflexes. Paralysis remains symmetrical; no lack of correspondence between motor and sensory paralysis; paraplegia always complete. Has remained consistently paralyzed. Has never at any time complained of severe sensory irritation or any unusual pain.

TRAUMATISMS OF THE MEMBRANES OF THE CORD.

It is stated that among the possible occurrences after twists, sprains, and contusions of the vertebral column is spinal meningitis. It is not infrequent to have writers referring to this subject speak, where a wrench of the back is the cause, of spinal meningitis, while not indicating in so many words that this is a constant occurrence. They partially suggest the idea that it is a somewhat frequent result.

An investigation of the literature in general indicates that among the ordinary consequences of twists, wrenches, sprains, and contusions of the spinal column, meningitis is mentioned as occurring with seeming frequency. In fact, to any one who is not thoroughly informed, the idea would naturally occur that every case wherein we had a twist, wrench, sprain, or contusion of the back spinal meningitis had to be unceasingly looked for, and when it did not occur one might congratulate himself that a most serious complication had been avoided. While realizing the possibility of spinal meninigtis following these injuries, still it is a fact that it is of such remarkable rarity that it may not be met in a lifetime of extensive experiences with injuries. So infrequent is its occurrence that we are forced to the conclusion that predisposition is immeasurably the strongest element in its production. Its occurrence at any time, owing to its extreme infrequency, makes it a marked exception. It is just to admit that in children light and apparently insignificant blows have produced meningeal troubles; where the aged are concerned any condition of a serious nature may attend traumatisms. No literature at present extant will indicate that the adult has anything more than the slightest predisposition to their occurrence.

Severe injuries to the back are followed immediately by definite and distinct symptoms indicative of contusions, fractures, and dislocations, but any writer familiar with the subject will state that chronic inflammation of the membranes and of the spinal cord are of extreme rarity in railway injuries. Such common diseases as transverse myelitis and progressive muscular atrophy can only in a very small proportion of cases be attributed to traumatism. It is an established and remarkable fact that these undoubted cord lesions are met with very rarely indeed in persons who have previously suffered from accidents or injuries. The writer has not in his extended experience of over thirty years been able to meet with a case of locomotor ataxia which could be attributed to railway injuries. Only in one case was such cause claimed, and in this, after close investigation, the disease was shown to have existed many months before the supposed injury occurred.

C. K., aged 39, switchman, was on an engine when it became derailed. The accident was of such a trivial character that the foreman reported that no one was injured. On investigation it was found that C. K. had symptoms of tabes as far back as October, 1901, and had been treated at the hospital for the same. The accident occurred Jan. 22d, 1902, so that there could not possibly have been any connection between the two, except to intensify symptoms.

INFREQUENCY OF CHRONIC SPINAL MENINGITIS.

Bramwell[1] directs special attention to "the extreme rarity of chronic inflammation of the membranes of the spinal cord, a condition which was supposed by some writers to be the cause of the nervous symptoms in cases of railway accidents and injury—as a result of blows or fall on the back, or other forms of injury. Injuries—severe injuries—to the back are followed immediately by distinct and definite symptoms indicative of concussion of spinal cord and are of common occurrence. Such common diseases as transverse myelitis, locomotor ataxia, and progressive muscular atrophy can in olny a very small proportion of cases be attributed to traumatism. It is a remarkable fact that these undoubted cord lesions are met with very rarely indeed in persons who have previously suffered from railroad accidents or injury. Some of these injuries were so common that on the mere theory of chances they ought every now and then to occur in persons who have been injured in railway collisions. The wonder is not that they do occur but that they so rarely occur. The possibility of the mere coincidence of occurrence must be remembered. The fact that such a disease as locomotor ataxia does develop after injury to the back does not establish a causal relation. Each case must be individually considered before any such conclusion can be arrived at." The writer believes that Erb has established beyond all doubt that tabes is of syphilitic origin. Diseases of the membrane from traumatic origin are characterized by symptoms connected with the sensory nerves and roots of the nerve. Backache may involve quite an extended portion of the column and may be present when the person is quiet. This pain in the back arises from irritation of the sensory nerve; motion naturally increases the pain. The most constant symptoms of meningitis are retraction of the neck, opisthotonos, and orthotonos. These are not due to inflammatory trouble of the spinal meninges, but are dependent upon an involvement of the cerebral meninges. The amount of contraction and a limitation of motion depend upon the severity of the case. In severe cases the muscles are excessively stiff and rigid, and permit no motion whatever, while in mild cases motion is limited. Irritative symptoms of the sensory roots manifest themselves by increased sensitiveness, or hyperæsthesia of the skin and muscles over which the sensory roots preside. Pressure from extravasation and exudation may cause paralysis when several or more roots are involved. Paræsthesias, or neuralgic pains when the motor roots are involved, muscular twitchings are evident, motor paralysis is flaccid when present and results from meningeal inflammation. The same symptomatic picture is present as when lesions of the cord exist.

---

[1] Dr. Byrom Bramwell: "Concussion of the Spine, with Special Reference to Railway Accidents and Injuries." London Lancet, August 12th, 1892.

EXTRAMEDULLARY HEMORRHAGES (HÆMATORRHACHIS).

Hæmatorrhachis is generally associated with severe and grave disturbances of the spinal cord and injury to the vertebral column. The hemorrhage is chiefly venous and generally arises where there is laceration of the large veins, since the arteries are rarely involved. The hemorrhage takes place internal or external to the dura mater. The hemorrhagic flow is downward within the vertebral canal, so that the situation of the bleeding focus determines the extensiveness of the symptom; the higher the location of the hemorrhage the more likelihood of greater involvement of nerve elements. The space into which hemorrhage occurs being large, the signs of pressure are not usually very prominent. A hemorrhage may occur in the clavicle region and spread through the entire canal. Nerve disturbances depend upon the part involved and the amount of pressure existing. No regularity as to pressure is observed, since there may be sensory disturbance without motor symptoms. The symptoms may be confined to the upper extremity. Symptoms as a rule occur rapidly and are well marked within twenty-four hours. Exacerbations may occur within two to five days. They generally improve and disappear within a month or six weeks. In perforating injuries both intradural and extradural hemorrhage can occur at the same time. The discussion as to whether there can be traumatic intramedullary hemorrhage occurring as a distinct lesion without injury to the spinal cord is, up to a certain point, interesting, *i.e.*, a pathological curiosity. This, and a number of so-called pathological conditions of the nervous system claimed to be caused by trauma, only serve to keep in mind many points which we deem may be of interest, which we are, however, unable to see.

Traumatic Hæmatomyelia.

The most important cause of hæmatomyelia, or hemorrhage into the cord, is trauma. True hæmatomyelia into the substance of the spinal cord is extremely rare. The writer in 1896 wrote to twenty-nine of the leading neurologists of the United States, asking among other questions the following:

"What number of cases of intracord hemorrhage (hæmatomyelia) have you seen and treated? Are they frequent or infrequent?"

Twenty-nine answers were received. From the reports thus received up to that time only sixteen cases had been seen and treated. Four of these were non-traumatic and twelve were of traumatic origin. From this may be inferred their relative frequency of occurrence. Charcot taught that primary hemorrhage into the cord did not occur. Hayem expressed the same idea. Hutin was the first to describe primary hemorrhage into the cord. Primary traumatic hæmatomyelia is caused by sudden and excessive movements, as enforced extension or flexion of the spinal column, thus stretching the cord so as to involve its integrity. The spinal column may remain intact, be dislocated or fractured. As a general thing there is only a slight destruction of the nerve tissues. Contusions of the cord are not, as a rule, followed by hemorrhage. The most movable parts of the vertebral column are affected. Hæmatomyelia occurs more frequently in the cervical region where the cervical enlargement of the cord, with its abundant gray matter, seems to be the point of election. Hemorrhage usually takes place into the soft vascular gray substance (*central hæmatomyelia*), although at times the white matter suffers. There may be a number of distinct hemorrhages or a single hemorrhage; a single hemorhage may spread in the gray substance, producing paralysis; this is called *tubular*. Cases have been reported as occurring in the lumbar enlargement, but no well-authenticated case has been known to occur in the dorsal region. The symptoms of hemorrhage into the cord generally appear at once, and reach their limit within an hour or two. At times the symptoms may be slow in appearing; when excessive hemorrhage complicates the case a fatal termination is soon reached. Symptoms indicating temporary pressure generally disappear within a day or two. The symptoms manifest depend upon the injury and amount of hemorrhage existing, and differ in no way from the symptoms found in complete transverse destruction or partial destruction of the cord. These hemorrhages may involve any portion of the transverse section of the cord, producing symptoms according to the portion of the cord involved. When the hemorrhage extends and pressure results, complete paraplegia may follow, or a temporary condition may be established resembling complete transverse lesion, depending upon the extent of the nerve tissues involved. There may occur symptoms of a partial or unilateral lesion. In the event of the oncoming of violent irritation, sensitiveness to pressure, radiating pains, and rigidity of the injured section point to hemorrhage of the membranes of the cord, and not to hæmatomyelia.

In rotation dislocation severe cases of hæmatomyelia have occurred. When there is injury to the posterior root or posterior horns of the cord, pain is felt corresponding to the location of the hemorrhage. A correct diagnosis depends upon a careful study of the nature of the injury, the manner in which the symptoms develop, and the manner in which they disappear. When absorption of the hemorrhage takes place rapidly, the prognosis is more or less favorable, but a persistence of symptoms leads in consequence of the paralysis to cystitis, pyelonephritis, or decubitus. It is asserted that complete recovery is possible where the injury is slight. Of course prognosis will vary according to the position and intensity of the lesion. If tissue has been destroyed, the prognosis is unfavorable as to recovery of the use of the parts.

Concerning the Use of the Term Traumatic Syringomyelia.

When the breadth of trauma is considered as to its possibilities, particularly in the direction of its being the cause of almost all pathological nerve conditions, it becomes assumedly all-embracing. Hence the assertion, that existing medical knowledge will not permit us to say that there is any one disease of the human body that cannot be caused by injury, except possibly one of an infectious nature, is somewhat strained. When it is considered how infinite is the number of conditions which exist in the human body beyond our knowledge or interpretation, the assertion that trauma can be a cause of any or all nerve troubles is at best a misleading assertion, certainly not an established fact. Possibilities are things which we can fancy or imagine; facts are things which we can generally demonstrate. The tendency upon the part of recent writers to apply the qualifying term "traumatic" to almost any nerve trouble is, in the writer's opinion, reprehensible, and tends to complicate instead of simplifying the classication of nerve traumatism. Because the symptoms created by hemorrhage into the gray substance may be at times the same as that described in syringomyelia, therefore there must be a pathological condition known as "traumatic syringomyelia." Henle[1] says: "It is not improbable that this central gliosis and cavity formation may be secondary to hæmatomyelia, because the lesions produced by injury become filled with gliomatous tissue which later undergoes cystic change. Schmaus claims that cavities develop following injury to the cord, due to circumscribed softening and on account of degeneration of newly formed gliomatous tissue. Wagner-Stolper believes that the stretching of the cord produces small fissures without extravasation of the blood." Bailey[2] does not believe that the use of the term "traumatic syringomyelia" is justifiable, and very sensibly states "that there are two possibilities. One is that trauma by causing hemorrhage into central gray matter that is already diseased calls forth into activity a latent myelosyringosis. The other possibility is that central hæmatomyelia, as described, . . . may cause permanent symptoms similar to those of syringomyelia. . . . For in the first the trauma would merely be a contributory cause; and the second, while it might in its symptomatology be identical with syringomyelia, would be so different in pathogenesis that nothing would be gained by giving it the name of a chronic progressive disease, when its own name of traumatic hæmatomyelia so well describes it."

Locomotor Ataxia.

The writer does not believe that it can be demonstrated beyond all doubt that trauma is at any time the sole cause of locomotor ataxia. He believes that Erb[3] has demonstrated syphilis to be the etiological factor in all cases of tabes. The fact that such a disease as locomotor ataxia may develop after injury to the back does not necessarily show that it is due to the injury. It is an easily demonstrable fact that undeniable cord lesions are remarkably infrequent in persons who have suffered from railway injuries. Investigation and study of railway injuries at times make many anomalies apparent. The writer has never seen a case of transverse myelitis except in lesions of the cord from fractured vertebræ, etc., progressive muscular atrophy, or locomotor ataxia, arising in persons who have previously suffered from railway injuries. Nor has he seen a case of spinal meningitis resulting from injury except in fractures and dislocated vertebræ. There can be no doubt that, in the presence of syphilis, trauma may be a powerful exciting factor, and, at varying periods after accident, tabetic symptoms may develop. Hirt mentions the case of a patient of his who contracted syphilis twenty-nine years before he met with the accident, and a few months after the accident tabetic symptoms developed. Trauma may then arouse a latent syphilitic condition and hasten the development of locomotor ataxia.

---

[1] *Loc. cit.*

[2] Bailey in Golebiewski's "Atlas and Epitome of Diseases Caused by Accident," p. 174, 1900 edition.

[3] The additional material collected since his last publication on this question, that is, since 1896, consists of four hundred cases belonging to the more educated classes. Of these, 88 per cent gave positive evidence of

SO-CALLED CONCUSSION OF BRAIN (COMMOTIO CEREBRI).

In the early consideration of concussion of the brain many confusing elements became manifest, all of which rendered this subject vague and theoretical. So many inconsistencies sprang into view that for a long time much confusion clouded the subject, thus rendering proof vague and uncertain. For example,

---

a previous syphilitic infection; of the remainder, only 3 per cent gave absolutely no history of a previous syphilitic infection. This small percentage may well fall within the limits of error which even a material wholly syphilitic might be expected to give. Erb goes with great detail into the objections advanced against his theory and exposes their weakness most convincingly; especially is this so in regard to the objection so often advanced by the opponent of the syphilitic theory, that is, the nonexistence of tabes in syphilitically infected districts or where syphilis has become endemic. Bosnia, Herzogovina, Abyssinia, etc., were supposed to have no tabes, although the people there were syphilitic to a marked degree. Erb shows that in the latter country there are four times as many tabetics in a hundred nervous cases as are found in Vienna. He further proves that the statistics concerning the occurrence of tabes in these countries have been very inaccurate until the most recent times. He concludes with this dictum, which from his standpoint may be considered final: "Tabes is without doubt, in by far the greatest number of cases, a syphilitic disease, but it is not yet definitely determined, but altogether probable, that it is the etiological factor in all cases."—S. I. Schaub, Interstate Medical Journal, Jan., 1905.

cases presented themselves where during the life of the injured person severe and dangerous symptoms of brain trouble were manifest, but where an autopsy was held the observer could not find the slightest trace of visible alteration in the brain substance. Again, patients were studied in whom there existed during life no involvement either of the psychical sphere, general sensorium, or of motor or sensory functions, and yet an autopsy would reveal that the entire frontal lobe of the brain or some other part of a hemisphere was a pulpified mass. Thus showing in one instance (during life) the severest brain symptoms, with no discoverable anatomical alteration of brain ; while, strange as it may seem, another case upon autopsy would show extensive and palpable destruction of brain substance, although during life there were at no time any brain symptoms manifest.

Space will not permit consideration of all of the theories connected with concussion of the brain ; besides, they are no longer tenable. It has been thoroughly established that blows upon the hollow skull change the form of the skull by virtue of its elasticity, and that, unless completely fractured, the skull resumes its former shape. Brain substance and the skull have different degrees of elasticity ; any degree of violence which permits the skull again to take its original shape produces proportionate contusion of the brain. Such being the fact, any change in form of the skull and brain is considered the cause of that group of symptoms which we call concussion of the brain. If, then, these ideas of concussion of the brain as expressed be correct and true, concussion of the brain would appear to be contusion of the brain after all.

Bergmann[1] in his recent work says : "The author has no objections to consider cerebral concussion as a form of contusion or crushing, and to place it in the respective section on head injuries if clinical experience did not teach otherwise. Owing to the fact that a patient may rapidly and completely recover from such severe cerebral disturbances, and also to the fact that such a patient continues to remain in perfect health, it is not easy to assume a solution of continuity of the brain as a cause of the symptom observed. As the patient recovers consciousness within a few minutes, one can only think of a momentary effect that disappears without leaving traces. . . . In addition, then, is the fact that affections of the central nervous organs have been produced experimentally, without occasioning any discoverable solution of continuity of this substance. Therefore, surgeons have been led to accept a physiological basis for the disease. This was furnished by Koch and Filehne, and even at the present time the author considers their researches of the greatest importance. Both experimenters conceived the idea of producing the same effect by a series of light blows as by one severe blow. By this method of investigation all disturbing and conflicting complications were excluded, and cases of pure concussion (commotion) were actually produced in which there was a momentary and immediate effect on the nervous tissue. For one stunning blow there was substituted a series of light blows, and the complete picture of concussion was produced on animals without any anatomical lesions of the brain. The temperature of the animals fell two degrees, respiration was shallow and slow, and the pulse rate was slowed from 58 to 36 beats a minute. The animals were powerless and could be placed in any position without resistance, as if absolutely and completely unconscious. On autopsy no rupture of any vessel was found. The parenchyma of the brain, the medulla, and the spinal cord were absolutely free from contusions or other mechanical lesions. In the animals which had received blows there was a complete and fully developed picture of cerebral concussion, and yet there was a total absence of any discoverable cerebral lesion."[1]

---

[1] "The term 'cerebral concussion,' as generally employed, is indefinite and unsatisfactory, and inconsistent with modern ideas of pathology and precision."

It is claimed that no one centre included in the brain is affected, but all are altered in the same way and at the same time. Hence the mere idea of cerebral concussion must be retained for the reason that it passes over rapidly without traces, and because numerous individuals have died as a result of cranial injuries where there were no discoverable anatomical lesions. Wherever we find destruction of the brain tissues it must be considered contusion. Again, Bergmann says: "Following the views on cerebral concussion Kocher has recently gone further and has attempted to distinguish concussion from both cerebral compression and cerebral contusion, or, as he himself has put it, 'concussion occupies a position between contusion and compression.'"

[1] "A System of Practical Surgery," by Prof. E. von Bergmann, Prof. E. von Bruns, M.D., and Prof. I. von Mikulicz, M.D. Lea Bros. & Co., pub., New York and Philadelphia, 1904.

The generally accepted belief is that compression is dependent upon disturbances of circulation; contusion depends on an apparent destruction of brain tissue with blood extravasation, and, as before stated, concussions where cases recover rapidly are due to momentary anæmia; in protracted cases they are due to a combination of circulatory disturbances, with disseminated microscopical effusions, which at times are limited, or may extend over wide areas. Cases of concussion should be considered according to their character and divided into mild and severe, depending primarily upon the force of inflicting agent. Naturally, cerebral concussion depending upon the fact that the skull after a blow, owing to its elasticity, resumes its former shape, injury must be inflicted upon the cerebral mass. Hence, we find disturbances of consciousness, extinction of intellectual powers, at times coma and stupor, loss of muscular power, involvement of sensation and reflexes, slowing of the pulse, restraint of the respiration, at times vomiting. In mild cases symptoms subside, and the patient goes on to uninterrupted health. At times there is more or less loss of memory, but patients most frequently recover from loss of consciousness with their minds in normal state. In some cases the defect of memory may remain.

Again, circumscribed functional disturbances may become evident, but they usually disappear, but there are times when they may persist to greater or less extent. It is believed that a good many functional disturbances may be dependent upon predisposition, but in the great majority of instances they are mainly dependent upon the amount of injury inflicted upon the cerebral substance. Among functional disturbances, circumscribed in character, may be defects in speech, such as stammering and difficulty of articulation, confusion of ideas, disturbances in the co-ordination of motion, and loss of equilibrium.

It has been asserted upon good authority that disturbances of metabolism and of the functions of the kidneys have been observed to follow cerebral concussion, namely, diabetes and albuminuria.

In the severer forms of cerebral concussion the patient is deeply unconscious and remains absolutely motionless, and it is impossible to arouse him in response to external irritants. Deep respiratory efforts alternate with superficial; at times the breathing stops entirely, to begin again with spasmodic inspiration or deep sighing. The pupils in all cases respond to intense light. The face is pale and haggard, the pulse is feeble, irregular, and vacillating. Vomiting immediately follows the injury, and is at times somewhat persistent. As in all shock, the urine may be retained, and the fæces voided involuntarily. This period of depression just described may persist for hours or days. Reaction is manifest when the respiration becomes deeper and deeper, the body warmth pronounced, the heart's action strong, the pulse full and firm. As these symptoms improve and consciousness and motion return, reaction becoming intensified, the pulse is full and bounding, decided heat of the surface is evident, the face is now flushed and not pale, the pupils of the eye are more or less contracted, but the eye is bright.

The greater the degree of cerebral involvement, the longer the stage of coma. This condition of coma points to the possibility of other intracranial complications. The rapidity with which a patient recovers consciousness confirms the diagnosis of a pure cerebral concussion. Bergmann's conclusion is a just one, when he says "there is only one criterion regarding pure cerebral concussion, the transient character of its manifestation."

To sum up the sequelæ of concussion, they are: amnesia (loss of memory), an inability to remember occurrences preceding injury, at times capricious memory. Besides these, we have such subjective symptoms as headaches, vertigo, insomnia, restlessness, or general nervous condition. Objective symptoms: attacks of dizziness, involvement of memory, and at times paralysis of cranial or peripheral nerves.

The condition of the patient at the time of the injury generally influences the sequelæ of brain concussion. Syphilitic and alcoholic subjects, and those having hereditary predisposition, may develop epilepsy. Insanity may follow cerebral concussion, but this will be spoken of in another portion of this article.

Cerebral Compression.

Cerebral compression often occurs as an accompaniment of concussion. It may result from cerebral hemorrhage, or be due to the pressure of fractured cranial bones. The face is flushed, while, as we stated, in concussion it is pale, the eyes are bright, but the pupils are contracted. As the compression proceeds, the patient becomes unconscious, with a rapid, feeble pulse. If paralysis occurs, the urine and fæces may be voided involuntarily. In fatal cases death ensues rapidly. In cases where compression symptoms disappear, they generally abate instantly. The same sequelæ may follow compression that follow concussion. It is stated by Golebiewski[1] that "compression due to depressed fracture is occasionally followed by cerebral epilepsy."

TRAUMATIC EPILEPSY.

Experience constantly demonstrates that trauma is competent to set free and arouse to action a long list of inherited troubles, particularly those in connection with the brain; trauma acting as the exciting cause, and the special predisposition of the patient being the real and true formative basis of the disease manifest. In no disease do we have any greater predominance of heredity than in epilepsy, since it influences its entire etiology. The true position of trauma in the production of epilepsy (especially following cranial injuries) is far from being settled. The attempt to make a correct basis of percentage of epilepsy arising from cranial injuries, by inspection of the United States pension rolls accumulated from the late Civil War, must be looked upon with extreme doubt. Any one acquainted with the methods used in reporting could not view them in any way as even approximately correct. Bergmann[2] uses these (pension rolls) to establish the percentage of cranial injuries producing traumatic epilepsy, making a percentage of 13.7, which is certainly exaggerated. Out of 82,360 railway injuries tabulated by the writer, the following shows the number of head injuries: Abrasion of head, 164; concussion of brain, 115; contusions of head, 1,167; fractures of skull, 249; lacerated wounds of head, 2,523; incised wounds of head, 191; gunshot wounds, 22; making a total of 4,431 head injuries. Out of this number only two authenticated cases of traumatic epilepsy were developed. Certain it is that in railway injuries traumatic epilepsy is of remarkably infrequent occurrence. Actual injuries to the brain are followed at times by epilepsy, or where injury produces changes in the bones of the skull, or dura mater of the brain. A fracture of the skull may cause firm adhesions between the dura and bone, or hyperostosis at site of contusion or fracture. Again, epilepsy may result from a peripheral-nerve lesion, the soft parts covering the skull, usually in the site of a scar. The changes in the properties of the brain which cause epilepsy are not known, since neither gross nor microscopical investigation shows any change; that epilepsy occurs is known, but how cannot be explained. Cranial injury acting as an exciting cause with an inherited predisposition is productive of epilepsy, but as to the fact of cranial injury creating unknown changes in the brain without the aid of heredity has not been absolutely demonstrated.

---

[1] "Atlas and Epitome of Diseases Caused by Accidents."

[2] *Loc. cit.*

The production of reflex epilepsy of this kind has demonstrated that in injuries of the extremities after complete cicatrization of a wound certain peculiarities of the scar take place. The scar acts as the exciting cause, producing an epileptic attack. According to Bergmann, "it frequently involves one of the larger nerve trunks, the sciatic more frequently than any other nerve." The scar is sensitive to pressure, and when pressure is exerted may react in epileptic seizure. For this reason investigation of scars should at all times be made in epileptics, since excision has resulted in a large number of cures. Scalp wounds and their consequent cicatrization appear to be more frequent in the production of epilepsy than scars in any other region. There is no essential difference in the influence of bone scars and those of the soft parts. It has been considered by many writers that depressed fractures of the skull were especially and peculiarly favorable to the production of epilepsy, but this has not been demonstrated. It is believed that fractures of the vault which have healed with loss of brain substance are a favorite site. Some writers believe that it is more a matter of change in the brain than it is in the bone, since in localized fractures of the skull the cortex is almost always contused, producing actual brain lesions, and where the cortex is affected it is followed sooner or later by epilepsy. In such instances head injuries followed by epilepsy appear to be a matter of involvement of brain. Epilepsy following injuries to the head appear to be more frequent when lesions of the brain are produced, and are seemingly dependent upon subsequent changes in the brain cortex. Destructive lesions of the cortex producing a localized affection known as Jacksonian or cortical epilepsy, Hughlings Jackson has shown that after irritation of the cerebral cortex definite and distinct convulsions originate from the irritated cortical centres. These epileptic convulsions are confined to the side opposite to that of the head injury and are connected with inflammatory foci, scars, degeneration of tissues, and found in the upper portions of the parietal region. In Jacksonian epilepsy the irritation, starting from one portion of the cortex and radiating outward to other parts, causes a spasm seemingly in the muscles, continued in the centre first irritated and passing to other muscles represented in adjacent centres. The order of the spasms aids in determining the situation of the lesions; thus a spasm beginning in the thumb, then extending to the fingers, then to the hand, to forearm, arm to the shoulder indicates irritation of thumb centre of cortex, then successively the centres for the finger, hand, forearm, and arm. Naturally, then, the cause of Jacksonian or cortical epilepsy being due to recognizable anatomical change in cerebral cortex, and the order of spasm showing the region of cortex involved, an operation for the removal of degenerated portions of brain becomes a sensible and proper procedure. Operations of this kind became frequent, but have not met expectations of operators; incidental complications and erratic features in post-operative cases render this field of operation extremely uncertain. The positive value of removing cortical centres involved in epilepsy is still undetermined.

MENTAL DISEASES FOLLOWING CRANIAL INJURIES—TRAUMATIC INSANITY.

Mental diseases following injuries of the head are of comparative rare occurrence. There appears to be some diversity as to the per cent of head injuries terminating in insanity. Hamilton says: "It is popularly supposed that head injuries are most fruitful causes of insanity. Statistics do not appear to prove this to be the truth, for at the large Scotch asylum under Clouston's care were but twelve cases directly due to these and to sunstroke, or one-third of one per cent of all admissions during nine years. Yet many irregular psychoses are undoubtedly traumatic." Bergmann asserts that of 18,608 cases of insanity, cranial injury was assigned as the cause in 480. Stolper's observations show that "among 981 cases of cranial injuries, there were 12 cases of mental disturbance, or 1.2 per cent.

Nearly all these cases, with one exception, perhaps, were severe fractures of the vault and base of the skull. If out of these 981 cases only the very severe ones are classified—and these are put down as 138—there would be 11 (or 8 per cent) cases with subsequent mental disturbance."[1] Again, out of 4,102 head injuries tabulated by the writer, there were 6 cases of traumatic insanity; in 5 of these the psychosis followed immediately after the injury; 1 developing six weeks after injury; 5 of these cases following fracture of the skull, 3 were fractures of the vault, and 1 a basic, the other was evidently due to intracranial injuries. The symptomatic picture of traumatic insanity delineated by different writers presents much contrariety of view, particularly from the neurological and surgical sides of the question. Bergmann reports that in five cases under his care the cranial injuries were followed immediately by loss of consciousness and a condition of stupor, the same as after severe concussion of the brain. This condition continues sometimes for a few hours, frequently a week, then passing into a stage of intense excitement, insomnia, and constant seizures of horror, with hallucinations, alternating with a tendency to violence. This last condition continues from two to three weeks, when the patient quiets down and comparatively rapid convalescence ensues. Hamilton, after stating that there are two general forms of traumatic insanity, says the first includes cases due to direct cerebral injury, and presents slowly developing motor symptoms, muscular weakness, varying degrees of hemiplegia, perhaps tremor, convulsions, headache, and vertigo; the mental state showing confusion with hallucinations and delusions. At times the patient gives way to impulses of homicidal nature; restraint is difficult. The disease sometimes suggests general paresis, and mistakes in diagnosis are apt to occur, particularly if epileptoid paroxysms have occurred. In the writer's experience traumatic insanity resulting from cranial injuries does not present any regularity as to the type of psychosis manifest, and he (the writer) cannot find in his investigations any uniform type of psychosis peculiar to cranial injuries. If it were not for the fact that recent writers insist that the only criterion determining pure cerebral concussion is the transient character of its symptomatology, Bergmann's description of traumatic insanity could be considered as being a typical description of severe concussion of the brain, rather than any typical form of traumatic insanity. Certain it is that ten years ago the surgeon would have described Bergmann's cases as cerebral concussion and not insanity. Kraepelin,[1] speaking of severe injury to the head as being the origin of mental troubles, says: "It cannot of course be denied that very often one has perhaps too readily assumed a connection of that kind, especially if a long space of time lies between the accident and the gradual development of the mental disease. We know so miserably little about the true causes of insanity that we must be extremely cautious when conclusions, as to cause and effect, have to be deduced from a lax sequence of time." Two forms of insanity follow cranial injuries: First, when the mental disturbance follows immediately on the injury. Second, after head injuries, a variable interval occurs before the mental trouble manifests itself, during which plainly evident prodromal signs are recognized. Another type is claimed by Hamilton and others, a type "supposed to be due to shock, in which there is no adequate history of damage to the cerebral tissue or resulting coarse disease." For years it has been the custom to assign to trauma the power to produce any form of insanity; the full effect and force of predisposition, previous condition before the injury, mal-effects of habits, etc., all have been lost sight of, and trauma has been given the preference as the cause in the production of mental troubles. There can be no doubt that cranial injuries are both a predisposing and exciting cause of traumatic insanity, but many authors agree that when such cases are thoroughly studied an inherited trait is more or less a constant and unceasing factor in their production. At the same time in judging all such cases it is very important to take into consideration the full force of the constitutional effects produced by trauma and the result of possible debilitating disease, causing impaired nutrition. The influence of overwork also, and brain strain, which would naturally aid and assist in developing a diseased mental condition, must not be overlooked. While there may be marked clinical elements distinctive of insanity arising from traumatisms, yet it has not been proven that any form especially is pathognomonic. Cases arising from traumatisms may be complicated with some existing constitutional taint, such as syphilis or alcoholism. If such a taint exists at the time of the infliction of the injury, it may certainly be a more potent cause than the injury itself. What concerns the reader more is the medico-legal aspect of cases of traumatic insanity. Inasmuch as the law will not consider speculation, but insists upon the production of evidence of usual natural and proximate facts, it is rare indeed for these cases to come up for consideration in courts of law. It is granted that many troubles and diseased conditions seem to be dependent upon trauma, particularly as regards the diseased brain, but unless immediate and proximate effects are well pronounced and plainly shown, the influence of trauma is not considered.

---

[1] Page 312, vol. i., "System of Practice of Surgery," by F. v. Bergmann.

---

[1] Page 242 of "Clinical Psychiatry," by Dr. Emil Kraepelin. William Wood & Company, Publishers, New York, 1904.

HERNIA.

Graser[1] makes the assertion that about one of every twenty or thirty individuals has a rupture of some sort. Bryant[2] says: "It (hernia) is met with in subjects of every social condition, but most frequently among the so-called working classes, because hernia occurs oftenest in the most numerous classes and not in the most laborious." He (Bryant) believes that hereditary predisposition is a reality, since a third of all cases show a predisposition in this direction. Kingston estimates that in about 34 per cent there is hereditary tendency to hernia. There can be no doubt that the constructive integrity of the abdominal walls is the moulding factor in many forms of hernia. It is also evident that weak places in the abdominal structures are prone to promote hernial protrusions. The inguinal canal is one of the most exposed, and at the same time one of the weakest spots in the abdominal wall of each and every man. The occurrence of inguinal hernia bears a positive relation to the integrity of the inguinal canal. A wide and straight inguinal canal would more readily permit the occurrence of hernia than one of the contrary character. There can be no doubt that a wide inguinal canal is frequently associated with lax abdominal walls and considerable separation of the pillars of the external ring with lax intercolumnar fibres. The external abdominal ring plainly indicates in a more or less perfect manner the formation of the inguinal canal. An abnormally wide external ring is apt to be accompanied by a wide canal and lax abdominal walls. Space will not permit the writer to discuss the various predisposing causes of hernia, but, as stated above, any cause menacing the integrity of the abdominal wall is likely to predispose to rupture. Kingdon's assertion "that hernia is a disease and not an accident, that it is a pathological condition and not merely a mechanical lesion," cannot be successfully controverted in the great majority of cases of rupture. This holds true in a pre-eminent degree regarding inguinal ruptures. In railway service there is not a marked proneness to rupture; it is not like those occupations which demand excessive strain and muscular effort on thoracic viscera, nor avocations demanding a fixed standing position combined with strong muscular effort, which, unimpeded, throw pressure upon every part of the abdominal cavity and walls, as in lifting and carrying heavy weights. Hernia in the great majority of instances is the product of muscular effort long continued, along with structural defect, and not the result of immediate and sudden effort. Hernia is always of slow formation, and very few persons are aware of its oncoming, because in its early stages it develops slowly and gradually and almost painlessly. No sphere of action is more completely filled with violent, sudden, and broad muscular use than the vocation of railroading. The railway surgeon, who sees thousands of accidents where every form of intense and sudden muscular effort has been used, and records the history of these accidents, becomes cognizant of the intense conditions demanding sudden, intense, and acute use, and finds rupture as a complication so remarkably infrequent that he is forced to the conclusion that sudden muscular effort is never a cause of rupture. If rupture comes under these conditions, it is only acquired or inherited defects which have led to its manifestation.

---

[1] "System of Practical Surgery," by E. v. Bergman, p. 483, vol. iv.

[2] "A Manual for the Practice of Surgery," by Thomas Bryant, Philadelphia, 1885.

It is not conceivable that any common-sense physician will believe that a sneeze or sudden cough could produce rupture, heredity being absent, when sudden muscular effort, probably a hundredfold stronger, constantly fails to produce it. The writer has never seen a case where sudden violence was given as a cause of rupture, but that suspicious elements were invariably present. Careful, close, and studious investigation and questioning will frequently disclose many points inconsistent with the statement of the patient. Probably violence as a cause of rupture is more frequently claimed where the railway is concerned than with any other corporation. Still, there are comparatively few persons contracting rupture upon the railway who claim violence as the cause. The following is the list of hernias tabulated: There were 289 ruptures, divided as follows: Right inguinal hernia, 98; left inguinal, 83; double, 56; scrotal, 12; femoral, 4; umbilical, 4; hernia following scars, 6; unclassified, 24. Out of this number only 163 claimed injury as an immediate cause.

In the earlier periods, when these records were commenced, many impositions were practised, but in the past fifteen years few cases of hernia have been seriously considered in the way of compensation. In the investigation of such cases occurring upon the railway in which rupture is claimed as due to violence, it is necessary to keep in mind the proper method of examination and the points to be determined. The writer in examining such cases invariably compares both sides of the abdominal walls prior to examining rupture. First, determine whether the person under examination has lax or weakened abdominal walls, which is best done in the supine position, then the condition of the external abdominal ring, whether there is any separation of the pillars of the cord, lax intercolumnar fibres, and whether the inguinal canal is wide and straight. Again, if the inguinal canal is wide, determine whether it is surrounded with adipose tissue or not. Graser[1] says, "Bager considers that complete absence of fat in the inguinal canal is characteristic of congenital hernia. The first attention should be directed to the healthy side and predisposing factors all noted; then, of course, the involved side is studied. It is unfortunate that there are no symptoms which can be attributed to hernia occurring by violence or accident. There are indeed very few cases in which the surgeon can find any evidence of recent rupture. If pain is present, it is due to stretching of the parietal peritoneum. It is an impossibility to tell, after a hernia is a week old, what was its manner of appearance, *i.e.*, whether it has been sudden or slow in its formation.

After a thorough examination has been made in the supine position, the patient is now made to stand, the size and extent of hernial protrusion are studied. It is just to assume if the patient relates that at the time of the occurrence he had an inordinate amount of pain, and had been more or less nauseated, but had consulted no physician, that he is misrepresenting facts. When the rupture is of considerable size and reaches down to the scrotum, and the canal is so patulous that the hernia can easily be reduced either in the supine or standing position, it is safe to say that the rupture is of long existence and not the result of recent accident or violence. When the hernial protrusion is high up and small in size and difficult of reduction, it may be possible that it has occurred suddenly. A small inguinal ring on both sides and a unilateral hernia of small extent likewise point to the possibility of sudden occurrence, due to violence. The writer has in no less tnan eight different instances, while examining rupture claimed as due to violence, shown the presence of a smaller one on the opposite side, and almost invariably has through this means, and close questioning, determined that the rupture which has been claimed as recent has been old, and the incident discovery of new rupture, up to that time unknown to patient, was so confused, that truthful statements were obtained. Family history, if adroitly elicited, often shows that members of at least one branch of the family were affected with rupture.

---

[1] *Loc. cit.*

The writer has never seen but one case of inguinal rupture in which the rupture was seemingly the product of immediate injury, and that was not really a hernial protrusion, but plainly a case where the muscular fibres of the internal and external oblique muscles were separated nearly three-quarters of an inch just above the internal ring, extending obliquely upward fully an inch and a half. The intestines could be freely felt by impulse when coughing. This patient was seen about ten hours after the accident, and immediate treatment prevented further complications. The peculiarities of individual anatomical construction has been considered above, but the influence of incomplete obliteration of the vaginal process in the peritoneal cavity in the possible production of inguinal hernia remains to be considered. The influence of the vaginal process in inguinal hernia is a mooted point. Graser does not believe with some authors that the vaginal process is of importance in all cases of inguinal hernia, nor does he believe with others that it is of no importance whatever. Both are in error, "since in some cases the degree of obliteration varies considerably. It is not common to have free communication between the vaginal process and the peritoneal cavity in later periods of life. It is more likely to close at the scrotal end, while it may remain patulous in the region of the cord as far as the internal abdominal ring. An equally as large number of cases are found where the vaginal process is closed below, but open above, thus forming a small funnel in the region of the internal abdominal ring." Prognosis in hernia depends upon the ability of the patient through the means of a well-adjusted truss to keep the hernia reduced. When the aperture or exit is well covered by the pad or truss and causes no discomfort, and experience shows that the opening is well protected, prognosis is favorable. Again, the size of the hernia always influences prognosis. A very large hernia is difficult to fit with a truss, owing to the size of the hernial ring and tendency toward protrusion of the hernial mass. There is always a possibility of strangulation when a truss is worn, since in intemperate and undue muscular exertion a truss may become displaced and strangulation result. In cases of irreducible hernia there is almost always a tendency to bowel trouble and enlargement of the hernia. That portion of the intestine outside of the abdominal cavity cannot be emptied by straining of the abdominal walls, hence alternating attacks of constipation and diarrhœa frequently occur. As a general thing, however, persons wearing a well-adjusted and properly fitting truss are free from symptoms of discomfort.

INJURIES TO THE THORAX, ITS WALLS AND CONTENTS.

Injuries to the wall of the thorax are frequent in railway accidents,[1] but they are rarely attended with serious consequences. But an excessive and astonishing amount of damage may be done to the viscera within, without any visible external evidence presenting itself. Under extreme and exceptional circumstances shock alone may be severe enough to prove fatal, and still no external evidence be present. The wonderful resiliency of the chest wall may be at times an aiding factor in causing injuries to the contained viscera, when excessive compressions and contusions occur, rupturing vessels, lungs, the pericardium, or heart. It is asserted "that the heart appears to exhibit results of concussion in many respects analogous to those manifested in concussion of the brain; indeed, fatal results have followed such injuries where even on autopsy no alteration was discovered."[1] When no external evidence of injury presents itself, the only sign is extreme shock, with great distress, and, at times, rapid and almost instantaneous failure of heart; dyspnœa is always present; sometimes it is immediate, or it may not occur for some time. Pain seems dependent upon severity of condition. It may be very acute, or completely enshrouded by shock and distress. Confused sounds of the heart are frequent, either audible or subnormal. The ultimate effects of such injuries, when tending to chronicity, of course depend upon the extent of the original injury. Tachycardia, intramural and valvular cardiac troubles may supervene. Excessive contusion or compression of thorax may cause rupture of lung more or less extensive, producing hæmoptysis. Emphysema occurs where there has been no fracture of the thoracic walls, and may under certain circumstances mask the condition of the injured lung. Vibert says "that it is not possible to reveal this condition by auscultation or percussion where the rent is located in a central part of the lung."[2] Permanent impairment of the function of the lung is dependent upon the extent of the injury to the lung. It is hardly necessary to refer to such various conditions produced by trauma as pleurisy, pleuritic effusion, and pneumonia, since physical signs are usually manifest which can be used to measure the extent of the changes engendered.

---

[1] Thus out of 82,360 railway injuries tabulated, we find 793 contusions and contused wounds inflicted upon various portions of the thorax. There were 613 ribs fractured, and in 11 instances the fractured ribs punctured the lung substance. Hæmoptysis was present and pneumonia developed in 11 cases; pleurisy developed in 16 cases, and was followed by effusion and chronicity in 4 instances; the sternum was fractured in 20 instances, fractured at the junction of the manubrium with the gladiolus in 14 cases.

---

[1] "American Text-Book of Surgery." W. B. Saunders, Philadelphia, 1895.

[2] Vibert says: "The pulmonary lesions which I have observed ought to be divided into two groups: first, there is a contusion of the thoracic walls; second, the walls remain intact and the disorders produced can only be explained by the concussion to which the whole mass of the body has been subjected, the effects of which are especially noticeable after thoracic contusions. And they are interesting, because, on the one hand, they persist very long, and, on the other hand, it may happen that they do not present any appreciable signs on auscultation and percussion. Hæmoptysis consequent upon traumatism of the thorax is explained by a tearing of the pulmonary tissues, which may occur without any fracture of the ribs and with an intact pleura. If this is located in a central part of the lung, and it does not form a large cavity, it cannot be revealed by any appreciable sign by means of auscultation and percussion. We know, moreover, that a tear of little extent can cause abundant and repeated hemorrhages, provided it involves vessels of a certain calibre."—Guillemand.

Hæmaturia Arising from Back Injuries.

Hæmaturia occurs[1] not infrequenlty incidental to contusions and sprains of the back, generally from severe contusion, strains, or wrenches of the lumbar region. To the laity the appearance of blood coming from some organ within is a source of great fright, and begets an anxiety upon the part of the injured individual seemingly proportionate to his intelligence; as we have seen slight hæmaturia produce such an effect. In one instance a locomotive fireman, on descending from his engine, lightly struck, as he said, his side upon the iron footstep. In a couple of hours, having discovered blood in his urine, he became an utterly shocked, relaxed, and fainting individual. This same man could have unflinchingly lost probably many times the amount of blood he had seen come from him if the source had been plainly indicated. He would neither have fainted nor presented any evidence of shock if he had received a blow in a combat, causing epistaxis; and such a hemorrhage might have been profuse and still not have worried him. Blood from an unknown source, and the fear of bleeding to death, always have their effects.

Position of Kidneys a Predisposing Cause of Injury.

Lidell[1] thus plainly and eloquently discourses regarding the kidney: "It will be remembered that the kidneys are two dense and rather brittle glands which lie close to the sides of the spinal column from the first to the third lumbar vertebræ inclusive, and outside of the peritoneum; that they are surrounded and held in place with considerable firmness by connective tissue containing much fat; that the right kidney projects downward below the last rib, and behind is covered with the quadratus lumborum muscle. Hence all violent flexions of the upper lumbar vertebral articulations, from sprains or wrenches, are liable to be attended by corresponding bends or breaks of the kidney; hence also the impact of powerful blows on the lumbar muscles may readily be transmitted through these muscles to the kidneys themselves with enough force to contuse or even tear those organs. Finally, the renal lesion, in the cases where it consists merely of contusion, or of slight rupture, or of contused laceration of the renal substance, is usually attended by hæmaturia."

---

[1] Hæmaturia (*aima*, blood; *ouron*, urine): blood in the urine; called also hæmaturesis. It is due to injury, local disease, general disorder, or the presence of entozoa, and to the influence of certain remedies.—Gould's Medical Dictionary.

[2] Lidell: Holmes' "System of Surgery."

General Causation of Hæmaturia.

When any predisposing cause exists, such as the presence of renal calculi, or where congestive conditions have rendered organs diseased, slight injury is oftentimes accompanied with hæmaturia. At times, owing to presence of hæmaturia, it becomes necessary to determine the source of blood in the urine, since renal colic and the movement of stone from the kidney downward, tumors of the kidney, urinary tuberculosis, and hæmaturia stand in relation to this phase of the disorder as hæmoptysis does to pulmonary phthisis. Injuries, tumors of bladder, certain kinds of food (owing to idiosyncrasy), malaria, entozoa, excessive use of certain medicines—all are causes of this symptom. Hence it becomes a matter of importance at times to determine the source of blood; whether it is incidental to and consequent upon the injury, or whether we have systemic conditions, dietetic or medicinal causes, or whether it arises from the presence of stone or tumor in the bladder, or some diseased condition of bladder or prostate gland.

Means of Diagnosticating Hæmaturia.

Mr. Hilton says, "In examining blood in the urine, swim out in water all clots whose origin is doubtful, in order that you may see their shape. Over and over again you will find yourself able to diagnosticate the case by this simple common-sense experiment."[1]

Hæmaturia incident to contusions and sprains can be determined most conclusively by the microscope, when blood casts of the uriniferous tubes are discovered. Blood coming from the kidney is usually so intimately mixed with the urine as to give the latter a smoky appearance. When we have hemorrhage coming from the bladder or prostate gland, from tumors, stones, etc., blood always follows micturition; that is, the order of things is reversed. Instead of coming first, as with hæmaturia, it always comes last in the conditions mentioned. Hæmaturia should not be confounded with hæmoglobinuria, a paroxysmal or toxic affection in which the urine contains, not the blood corpuscles, but their coloring matter, namely, hæmoglobin in solution.[1]

---

[1] Hilton's "Surgical Enquiries," second edition, p. 37.

PROGNOSIS REGARDING ULTIMATE EFFECTS OF HÆMATURIA ON KIDNEYS.

It is hardly necessary to specify the various causes, beyond what we have already done, productive of hæmaturia. What concerns us most in the consideration of this subject is the prognosis or the ultimate effects of these injuries. Suffice it to say that writers almost universally maintain that it is very rarely a dangerous symptom, as it generally disappears after a few days without leaving any apparent effect of organic disease behind. Thus, for instance, Legros Clark avers that after having witnessed many cases of hæmaturia arising in consequence of traumatism inflicted upon the kidney from this source, he has never had any reason to suspect that nephritis or organic disease followed. Mr. Shaw,[2] who has written very exhaustively upon this subject, makes the following remarks: "When such an important gland as the kidney has been crushed and broken to such an extent that hemorrhage goes on, from a rent in it, for several days, it might be thought probable that the damage would be followed by ulterior bad results; especially that nephritis would ensue. But extended observation negatives this view. General experience shows that when patients recover from the immediate effects of hæmaturia brought on by sprain of the spine, they are not more prone than others to renal complaint."

---

[1] Under certain circumstances it may be necessary to determine the presence of blood absolutely, as it is not considered safe to depend upon inspection alone, inasmuch as hæmoglobin in solution simulates the raw-meat color of the ruby red as found where blood is mixed with urine. Spectroscopic examination can be used; or Heller's test, where the urine is treated with caustic potash and boiled. The basic earthy phosphates are then precipitated, and together with them the hæmatin derived from the oxyhæmoglobin present. The phosphatic sediment is consequently colored a bright red. Should it happen that the urine contains abundance of coloring matter—bile pigment—which renders it difficult to appreciate the color of the sediment, the latter should be separated, filtered, and dissolved in acetic acid. The solution then becomes red if blood be present, and its color vanishes gradually on exposure to the air. Rosenthal applies the test for hæmin directly to dried precipitate. —Professor v. Jaksch, "Clinical Diagnosis."

[2] Guy's Hospital Reports, 1868.

Again, frequent evidences are found at post-mortem examinations of wounds that have been inflicted upon this organ, presenting perfect integrity of repair, naturally in consequence of the subcutaneous situation of the injury; where if microbic causes could produce changes these certainly do not seem to be intense, and do not lead to inflammatory sequences, or do so rarely. Our own experience does not indicate that ultimate troubles follow these injuries. All authors seem to indicate that these conditions are not generally very serious unless we have absolute rupture of the kidney. In the etiology of Bright's disease, while it is recognized that trauamatism may produce its initial stage, yet we do not know of a single instance of its production where a previous history plainly indicated its non-existence; nor have we seen a case in consequence of this condition where its production was immediate. We know that the slightest causes are aids in its production; yet, at the same time, we have no recorded instance where, immediately after receipt of injury, evidences were found which plainly indicated that the trauma was the immediate cause of parenchymatous nephritis.

ILLUSTRATIONS OF CASES WHERE TRAUMATISM PRODUCED ULTIMATE EFFECTS.

Odin mentions a case of acute nephritis following eight months after abdominal injury. After the occurrence of the injury, symptoms of renal contusion were quite apparent; among them, hæmaturia, which persisted for four days, and intense pain and difficulty in micturition. When the length of time intervening between the receipt of the original injury and the time when the pathologic condition developed is considered, is it not possible that other causes than traumatism were at work? May not microbic predisposing effects have made themselves manifest? Or, again, might it not be possible that previous traumatic effects were simply renewed and produced in consequence of some new but slight injury inflicted? Roussel, at St. Etienne's Hospital, mentions a case where traumatic trouble occurred in the kidney in which hæmaturia existed, pain and difficulty in micturition occurred. The case was treated in the hospital, and apparently cured; no albumin in the urine. Nine months afterward, as it was claimed, without having been exposed in any way, and without any imprudence, he returned with all the symptoms of acute Bright's disease. Here again we have a case where months intervened; where a history was plainly not kept up in the mean time; and where causes before cited might have had full sway. Again, according to the views of Herzog, indirect violence to the kidney always involves the hilum of the organ; while direct violence leads to laceration of the organ itself. This would certainly seem natural, as direct and concentrated force undoubtedly would seem more competent to produce laceration of the organ.

In a case where an individual was struck upon the small of the back by the lever of a hand-car, hæmaturia appeared; but the amount of blood passed was very moderate. He never recovered from shock, and died some eighteen hours after the injury. Upon post-mortem examination a large ragged tear in the left kidney, almost severing the organ, was found. The amount of blood passed in this case, as stated before, was extremely small, which was clearly explained by the post-mortem. The blood effused into the abdominal cavity extended below the kidney, almost filling the pelvic cavity. The peritoneum was ruptured, which is extremely rare.

MEDICO-LEGAL CONSIDERATION OF HÆMATURIA PRODUCING ALBUMINURIA.

The point which specially interests us is the medico-legal relations of hæmaturia from sprains of the back. Thus, Lidell,[1] in speaking of the medico-legal relations of hæmaturia, cites the following case:

"Mr. Shaw relates the case of a gentleman who claims in a lawsuit compensation from a railway company for Bright's disease resulting from injuries received in a railway collision. The injuries consisted of a bruise over the right ilium and side of the loin. On the following day, he observed blood mixed with his urine, and for four days he continued to pass blood. At this time his urine was found to contain albumin, and it continued to be albuminous from the date of the accident to that of the trial, a period of eleven months. The medical witnesses for the plaintiff held that the albuminuria, that is, parenchymatous nephritis, had been caused by the injury of the right kidney, which was afflicted in the collision. The medical witnesses for the defence—Mr. Shaw was one of them—expressed a strong opinion that the plaintiff was suffering from a disease when he met with the accident, and that the injury could not have brought it on. But to say that the injury could not have brought on the disease in this instance is tantamount to asserting that a traumatic lesion of the kidney, which manifests itself in hæmaturia appearing on the day following the accident and continuing for four days, cannot give rise to structural disease of the kidney of an inflammatory character. . . . There is, therefore, no reason for doubting that in at least occasional instances the injury which causes hæmaturia gives rise to Bright's disease. In the case just mentioned the jury, notwithstanding the medical testimony adduced by the defence, awarded heavy damages to the sufferer; and it may well be that the verdict was a righteous one. A legitimate inference from the foregoing, which has value for medico-legal uses, is that although some surgeons of large experience have never seen a case in which inflammation from contusions and sprains of the back was followed by nephritis or by organic disease of the kidney, nevertheless such cases do sometimes occur; and that whenever they do occur their existence ought to be recognized. It is also pretty certain that Bright's disease does not often arise from lesion or traumatism, but precisely how often, future experience alone can determine."

---

[1] Holmes: "System of Surgery," second edition, vol. ii.

In the case herein cited, the antecedent history of the individual was not given; and there is no proof presented that this person did not have albuminuria at the time or even before the injury was inflicted. Admitted that the burden of proof was placed upon the side of the defendant, and that the plaintiff was not supposed to testify against himself, still the mere fact of its not having been discovered does not inevitably make it so; for this disease may and does frequently exist before its diagnosis has been made.

Again, for years past, M. Dieulafoy has, both at the bedside and in his much-read work on "Medicine," sought to emphasize the importance of divers symptoms which, though often apparently trivial, are none the less significant of the existence of that very common malady, Bright's disease. To these symptoms he has given the name of "petite urémie," Brightism. He regards albuminuria as an unreliable symptom of Bright's disease (the London *Lancet*). In sixty cases under treatment in his wards during recent years, albuminuria was absent in one-fourth. That nephritis really existed was proved in several instances by post-mortem. In another series of cases, albumin disappeared in spite of the continued evolution of the disease. Some patients are albuminuric without being Brightic, to adopt the French expression.[1]

Hence we cannot see wherein this verdict was a righteous one. Suppose that the assertions made by Mr. Shaw were tantamount to asserting that traumatic lesion of the kidney, which manifested itself in hæmaturia appearing on the day following the accident, and continuing for four days, cannot give rise to structural disease of the kidney of an inflammatory character, still we have no proof of its immediate production.

INFREQUENCY OF ULTERIOR RESULTS.

The mass of evidence has shown for many years that ulterior results have been of great infrequency; that the prognosis is good; and that even under the most unfavorable circumstances a serious consequence is of extreme rarity. We know of no instance, excepting the one above cited, where traumatism and the attendant symptom, hæmaturia, were productive of, and immediately the cause of, Bright's disease. There can be no doubt that traumatism may ultimately occasion this trouble; as instanced in the following case, where a consecutive history was obtained, the patient being under constant treatment, and his condition daily watched:

J. M., a switchman, aged 22, was rolled and doubled up under the sand-board of an engine. When brought to the hospital all the evidences of excessive shock were manifest: pale, cold, clammy skin; husky voice; brilliant eyes; rapid, weak pulse; retention of urine. He had vomited several times since the injury. Knowing the limited space in which he was injured, we expected to find fractured and dislocated vertebræ, or injury to the viscera contained in the abdomen; but we failed to find such conditions. He complained of pain in the back, and a numb sensation in his legs which was fitful; no evidence of paralysis, either of motion or sensibility. Upon examination we found the spinous processes of the twelfth dorsal and first lumbar vertebræ out of line and slightly separated, plainly due to a subluxation of the vertebræ of limited extent. There was little or no bruising on the back, but he was plentifully bruised upon the extremities. After the inflammatory symptoms had subsided, a plaster jacket was applied. The urine was scant. It was examined at various intervals after the patient was able to be up and around. He continued to complain of more or less pain in the back—improved. Cast was changed for a leather jacket. In the third month, the urine was examined and found to contain slight evidence of albuminuria. The urine was watched daily from this time on. A month after, tubular casts were manifested under the microscope; anasarca gradually developed, with puffy eyelids, etc. This continued for nearly two months, but under treatment all evidence of albumin gradually disappeared, and eight months after injury he was able to resume his vocation. The urine has been examined many times since, but there has been no return of the trouble. He has been constantly at work for the past two years, and presents all evidences of being in thoroughly good health. In this case, while injury to the kidney was not indicated by the presence of hæmaturia, yet there can be no doubt, taking into consideration the manner in which this individual was injured and the limited space in which he was confined at the time of injury, and the extreme flexion of the spinal column, that the kidney was injured at the time.

---

[1] Medical Review, November 18th, 1893.

Another case, where the individual received a heavy blow on the right side of the back and loins, and where hæmaturia immediately appeared, under rest and treatment progressed to recovery without interruption. But the patient returned to the hospital some eight months afterward suffering from malarial complications. Albumin was discovered in his urine; under the microscope no casts were discovered. Upon treating the malarial troubles, the albumin disappeared. Probably the influence of malaria had as much effect in producing the trouble as the injury, but it was transient in any event.

CONCLUSIONS.

It cannot be doubted that organs, particularly the liver and kidney, are subject to traumatism of a positive and undoubted character, and that these internal injuries seem to heal with unusual rapidity, owing to their subcutaneous character. While realizing that scar-tissue is neoplastic, and is generally nature's completest repair, and that it can in no way be called normal tissue, and that under the many adverse conditions in which man is placed this tissue is easy to break down and be the focus of lesion, still when thorough investigation of these injuries is made, particularly as regards the kidney, a marvellous healing power is manifested, and the very infrequent occurrence of adverse conditions indicates the perfection of nature's reparative processes.

There is a natural tendency upon the part of the physician to deal in that which is remote or speculative, assuming oftentimes that what is extremely improbable will naturally follow; hence there is only one element upon which anything like a proximate and correct estimate can be drawn, and that is the accumulated experience of the profession, where years have shown results. There oftentimes arises, in consequence of a lack of the honesty which should characterize the physician, an utter indifference to the results to either corporations or individuals. Hence, while any physician might truly assert that hæmaturia arising incidentally to the infliction of an injury to the kidney might be productive of ulterior results, yet such instances have been shown to be so infrequent that they are only of the nature of mere coincidences.

CHAPTER III.

TRAUMATIC PSYCHO-NEUROSES, OR FUNCTIONAL DISTURBANCES OF MIND AND NERVES FOLLOWING RAILWAY INJURIES.

1st. Concerning the history of traumatic psycho-neuroses and synonyms.—2d. The necessity of considering railway injuries generally in the production of traumatic psycho-neuroses, in order that a correct conclusion may be reached.—3d. Classification of kinetic energy causing traumatic psycho-neuroses and other railway injuries.—4th. Kinetic-kinesic accidents.—5th. Bi-kinesic accidents.—6th. Mono-kinesic.—7th. Un-kinesic.—8th. Predisposition.—9th. Influence of suggestive surroundings—vocation.—10th. The neurasthenic type.—11th. Mental states.—12th. Motor disturbances.—13th. Muscular tremor.—14th. Reflexes.—15. Sensory disturbances.—16th. Hearing, taste, smell.—17th. Disturbances of the heart and circulation.—18th. The hysterical type.—19th. The mental state.—20th. Symptoms—21st. Sensory disturbances—22d. Hemianæsthesia.—23d. Hyperanæsthesia.—24th. Hysterogenic zones.—25th. Disturbances of vision.—26th. Disturbances of movement—paralysis.—27th. Paraplegia.—28th. Monoplegia—29th. Contractures.—30th. Hysterical joint affections.—31st. Disturbances of respiration and speech.—32d. Character of attacks, and general remarks.—33d. The grave traumatic psycho-neuroses.—34th. The difference between an hysterical attack and an epileptic fit.—35th. Subsequent progress seemingly dependent upon favorable surroundings and conditions.—36th. Some other causes in the production of functional troubles besides trauma.

CONCERNING THE HISTORY OF TRAUMATIC PSYCHO-NEUROSES AND SYNONYMS.

A CAREFUL study of traumatic psycho-neuroses, or functional disturbances of mind and nerves, following railway and analogous injuries, cannot fail to impress the studious investigator with the fact that their morbid manifestations at different periods in their history must have presented many points obscure and difficult of explanation. Few subjects in modern medicine have received more thorough study and deeper analysis than this subject under consideration, and apparently few have progressed so slowly.

A patient review of the opinions of various writers upon traumatic psycho-neuroses, from their first descriptive consideration up to the present time, plainly indicates an extreme degree of confusion as to the proper classification and nomenclature. In recent years much has been done to eliminate misleading and invidious terms, such as "railway spine," "railway brain," etc., and to remove the contracted and prejudiced views as to cause; that is, to show that these troubles may occur from accidents arising from many other sources than the railway.

The traumatic psycho-neuroses, or functional disturbances of mind and nerves, following railway accidents were first considered upon a basis so startling in their character, manner of infliction, and peculiarity of origin as almost to blind the investigator and compel him to accept the then stated conditions and causes, thus debarring a deeper study as to their real causative factors.

The misleading dramatic subtlety of the stated surroundings and peculiarities of these injuries for years broadly and pronouncedly influenced not only the medical and legal professions, but all other social factors brought in contact with it. Could the writer of this article but truthfully quote all of the strange and almost mystical beliefs and assertions morbidly ominous, threatening opinions, highly imaginative views, expressed by the medical and legal professions at various periods in the evolution of this question, it would only partially indicate the excessive credulity of the professional mind under scientific assertions. It is to be deplored that greater doubt has not been engendered in the study of this subject. Many recent writers appear to be still influenced by past assertions, and their work indicates their power of detailed compilation more than of new and original analysis.

A review of various synonymous terms used by writers upon this subject at divers periods in its history and evolution will serve forcibly to illustrate how extremely confusing and diversified have been the views held by these different authors. It will enable the reader to determine what elements of uncertainty in their etiology, classification, and nomenclature have been cleared, and what remain undetermined.

The position now occupied by functional disorders of the nervous system following railway injuries, we conceive, is owing to at least three important causes. When Erichsen wrote his first book, in 1866, under the caption of "Railway and Other Injuries to the Nervous System," then was the commencement of an era in commercialism hitherto unknown in the world's progress. From that period to the present time the constant and unceasing building of railways became the ponderous power to change the social and commercial factors of the earth. In 1869 Beard first described neurasthenia, a many-rooted morbid condition, which served to explain many diseased conditions hitherto inexplicable. Erichsen's book directed the mind of the world to the great possibilities of the rewards in litigation, particularly when the railway was at fault, in the production of functional troubles following injury. As the railways grew in power and aggressiveness the litigation increased; and, for a long time, the railway was held as being the only source in the production of these functional troubles. Neurasthenia broadened the symptom complex and became a forcible agent and incentive to litigation. Hence, so-called "railway spine," etc., the continued increase in railway mileage, the impetus given to litigation by broader and continuous study of neurasthenia, were the essential factors in placing functional disorders of the nervous system following injury in a position of being one of the most industriously considered subjects in medicine.

The study of functional disorders of the brain and spinal cord arising from injury was not a new study; but the idea of making the railway the marked and individual cause was new. Long before Erichsen had written upon this subject, the relation of hysteria to certain vague forms of neurotic disturbances in connection with injury was recognized by medical writers. However, it was not until Erichsen, in 1866, published his first book upon "Railway and Other Injuries to the Nervous System," that the study of functional troubles following injury became a marked and important one. In 1875 Erichsen published another work, under the title of "Concussion of Spine." He averred that the shock of the injury produced changes of the cord, leading ultimately to chronic spinal and cerebral meningitis. Erichsen's views of the effects of concussion were never sustained, since no satisfactory pathological proof of a disease of the spinal cord could be demonstrated. The terms created by Erichsen were "railway spine" and "spinal concussion." For years these terms remained unquestioned, but, in the general discussion following, some writers proclaimed that the brain was the primary seat of these functional troubles; then, for a brief time, a still more contracted term, "railway brain," was used. Dr. H. W. Page, surgeon of the London and North-Western Railway Company, in his works from 1882 to 1885, plainly indicated the share which the brain had in the production of these troubles following certain railway injuries. He described and recognized hysteria and neurasthenia as the real factors in their evolution. Almost synchronously with Page, Walton and Putnam demonstrated the similarity of these nervous troubles with hysteria. Some four or five years later, Charcot, in his "Leçons sur les Maladies du Système Nerveux," pointed out that hysteria was often developed by traumatism, and that the symptoms in traumatic cases were in no manner different from those present in hysteria arising from any other source. Incident to a constant discussion regarding the influence of litigation upon functional disorders of the mind and nerves arising from railway and allied injuries, the term "litigation psychosis" was, for a time, more or less used. Long and continued discussion arose in the consideration of these functional troubles as to whether the symptoms arising from railway traumatism were more of a neurasthenic than a hysterical nature; or, whether there existed nervous manifestations which could not be classified with either. This phase of the subject was particularly emphasized in the discussion of German authors. In 1889 Oppenheim advanced the opinion that while many cases following railway injuries presented symptoms of both neurasthenic and hysterical nature, there frequently followed after these injuries nervous symptoms which could not be rightly classed with either. To these forms of nervous troubles he gave the name "traumatic neuroses." More studied analysis of these conditions has proven the nonexistence of any special variety of neurosis peculiar to, and engendered by, railway injury.[1] Clevenger, of Chicago, wrote a book upon the subject of "Spinal Concussion," and proposed the name of "Erichsen's Disease" for the symptom group of functional disorders following railway injuries. Naturally, owing to the frequent occurrence of neurasthenia and hysteria after railway injuries, the terms "traumatic neurasthenia" and "traumatic hysteria" came to be used synonymously for these functional disorders.

---

[1] *Loc. cit.*

The value of many individual symptoms in these traumatic disorders are now held in more and more doubt, hence there are not lacking authors, or writers, who assert that many symptoms are in the nature of coincidents more than they are regular and constantly occurring morbidities.

In a recent work by Dr. Allan McLane Hamilton,[1] published in 1904, under the title of "Railway and Other Accidents," the author creates a new synonym to designate these functional troubles. He says "the term 'accident aboulia' has been chosen by the writer because it seemed more applicable to the condition manifested by a collection of symptoms of a hystero-neurasthenic nature, the chief of which is a loss of will power. This is undoubtedly the result of auto-suggestion, and the creation of one or more fixed ideas in connection with a deception of the sensory centres."

In addition to these terms used by authors, "spinal irritation," "spinal anæmia," and "hystero-neurasthenia" are more or less used.

From the foregoing it will be noticed that no less than ten different synonymous terms have been used to designate the traumatic psycho-neuroses, or functional disturbances of the mind and nerves, following railway and allied injuries. In recent years the labors of Thorburn, Knapp, Bailey, and Hamilton have been of much value, since they have cleared the subject in many directions, thereby tending to a broader and more just consideration of the subject. Still, we believe that at no period in the history of these troubles has there been any more uncertainty as to their proper classification and nomenclature than exists at the present time. The immense amount of labor, in a literary direction, expended to explain these functional troubles following injury would certainly appear competent to explain any subject or morbid condition in medicine supposedly as definite as this. It is no exaggeration to say that more than three hundred books and monographs have been written in the past thirty-nine years upon this subject.[1] There is no doubt that the endless occurrence of railway and other injuries, the spirit of acquisitive litigation, the unbounded field of morbid manifestations claimed as due to trauma, and the narrowed consideration of railway injuries as the cause of certain classes of disease, along with the still uncertain effects of trauma in general, have had much to do with this confusion.

---

[1] Medical Review, November 18th, 1893.

Again, Dana,[2] in an ably written paper on the "Partial Passing of Neurasthenia," convincingly maintains that so far as neurasthenia is now considered as a psychosis, or morbid mental state, it is just as essential and proper to consider it not as a definite diseased condition, but as comprising various psychical states of an elementary type. If these are carefully analyzed, it will be found that what remains of neurasthenia is a comparatively small number of cases of true fatigue neurosis. In the remainder are to be found cases of beginning dementia precox, paranoia, and various other psychical derangements which never pass beyond the stage of relatively slight alteration in the mental make-up of these individuals. There is no doubt that these individuals generally exhibit in their past lives a sufficient degree of neuropathic tendency to indicate that they are inherently candidates for the development of a psychosis, or morbid mental state, of one kind or another. Again, as a matter of curiosity and interest, there are points of difference concerning certain causes of neurasthenia; among them is whether excessive work alone will cause this trouble or not. Many writers assert that to produce neurasthenia it is only requisite that the element of overwork be present, whether the labor be mental or physical. Dercum[3] says: "Among the exciting causes of neurasthenia is, first and foremost, overwork. . . . It is commonly believed that neurasthenia is the outcome especially of overwork; sometimes, however, overwork that is purely physical, if long continued, leads to neurasthenia of the most intractable form."

---

[1] "After this the opposition to the admission into medicine of a traumatic neurosis as a distinct disorder became more and more general. At the Twelfth International Medical Congress, held at Wiesbaden, in 1893, it was generally accepted that even after slight injuries, general functional disorders not infrequently develop. These neuroses are not disease pictures of any special variety but may all be classified under the names of other well-recognized neuroses of which the most important are hysteria, neurasthenia, hypochondriasis, and their mixtures."—Pearce Bailey in "Text-Book of Legal Medicine and Toxicology," Peterson and Haines. W. B. Saunders & Co., 1905.

[2] "The Partial Passing of Neurasthenia," by Chas. A. Dana, M.D., Boston Medical and Surgical Journal, March 31st, 1904.

[3] "Nervous Diseases, by American Authors," edited by F. X. Dercum, Lea Brothers & Co., 1895.

Dana[1] says: "I have been watching for a case of neurasthenia due to excessive physical work alone, but I have never seen it. It does not occur, for example, as the result of long and hard athletic work, nor in bicycle races, or in six-day pedestrians, or in firemen and stokers. It is always the psychic that has to be hit in order to get neurasthenia."

Heretofore in the consideration of the psycho-neuroses, or functional disturbances of the mind and nerves arising from railway injuries, "it has been accepted as a curious fact that many persons engaged in occupations, or exposed in ways fraught with more or less likelihood of danger, rarely suffer from nervous conditions, while on the contrary, those who are unconscious of any impending injury, succumb at once upon its receipt."[2] It is asserted by Bailey that after an accident railway employees, with the exception of locomotive engineers, are less prone than passengers to develop hysteria and neurasthenia. This is explained in part by the fact that the former had become to a certain extent accustomed to the ordinary mishaps of railway travel, and, partly, because, for various reasons, an employee can ill afford to bring suit against the company; so that after an accident, if not severely injured, the employee usually returns to work.

For years we have accepted the time-worn and unceasingly repeated proposition that familiarity and experience upon the part of the railway employee with dangerous surroundings in his vocation, had with him a constant tendency to lessen shock from collisions, derailments, and allied injuries. It was natural to suppose that the employee in his daily duty becomes familiarized with the attendant factors of excessive momentum, power, and disaster. But, thirty years as a railway surgeon, treating from two to four thousand railway injuries annually, personal attendance at railway wrecks, personal and consecutive examinations made upon both passenger and employee thereafter, compels the author to believe that in the healthy, strong, active, and contented person, there is no essential difference, in either immediate or subsequent effects, between passenger and employee. Of course all classes of injuries are influenced by ill health, neurotic or adverse conditions, subsequent to injury. No sensible person will contend that the employee in his psychical and somatic make-up is in any way differently constructed from the passenger. We will admit that the employee has become familiarized with the attending dangerous elements of his vocation, but we cannot admit that any man with an impressionable mind can become superior and unaffected when brought within the horrifying forces welling up in railway wrecks.[1]

---

[1] *Loc. cit.*

[2] Hamilton, *loc. cit.*

---

[1] The writer had the privilege of examining the effects in a psychic way of a considerable number of persons who had passed through the St. Louis cyclone, which occurred May 27th, 1896, and which probably was one of the most extensive cyclones which have ever occurred to any large city. He was struck with a similarity of psychic shock thus engendered to what he had seen after railway wrecks. The psychical trauma was almost the same where sheer intensity of circumstance makes it productive of all the degrees of this as expressed by the words "fear," "terror," and "consternation." These persons told, some moodily, others haltingly and excitedly, how they had passed through a more or less great period of unconsciousness. "I did not know what had happened or where I was for some time afterward," was a common expression. One who has examined people at a railway wreck has frequently heard expressions akin to this: "The first thing I knew I found myself walking away." Others again experienced only mental obtundity. In several instances I was told by livery-stable men that a man would come in with a blank expression upon his face and say, "I want to go to this or that place." "You can't go," would be the reply of the liveryman, and without any further endeavor or argument the visitor would say, "Oh," or its equivalent, and walk away. There was a general obliquity to external impressions; persons seemed to be gazing into obscurity, during which time many voluntary acts were performed almost automatically. The higher mental field was alone being held in abeyance. People wandered aimlessly, unconscious of their surroundings or where they were going. On the faces of many could be noticed a blank, fixed expression, inattentive, blunted mentality, seeming inability to concentrate or think; some became boisterous, just as I have seen at railway wrecks. On one occasion I heard, not only one man, but several men, whoop and halloo at a trivial little thing, which at other times would have been unnoticed. Again, I have found the same change of voice after the cyclone as after the railway wreck; some talked with cyclonic explosiveness, while others had a halting speech; again, others had a whispered utterance. I have seen men after wrecks almost dance in glee when they found themselves uninjured. "Why are you talking so loudly to those men?" said a superintendent to a conductor who had just been through a wreck. "I beg pardon, sir, I did not know I was talking," answered the conductor.

We saw, after the cyclone, victims acting the same as after railway wrecks. The hysterical involuntary symmetry of movement was present, as well as that peculiar excitability of hysteria where energetic movements are necessary to prevent irritating mental effects.

"Say, Jim, are you batty? Better let up on your muscle stunt, or you will queer yourself," said one brakeman to his fellow-brakeman who had just come out uninjured from a severe derailment, and who persisted alternately in getting up on the seat and sitting down again at short intervals; each time he would get up he would strike out in front of himself several times in succession, as though he were exercising with dumb-bells. "No, I ain't batty," said Jim, "but, say, I am a little queer." This brakeman did not know what nervousness was up to this time. This was a case

Thus, when suddenly and without warning, one, be he employee or passenger, is caught amidst the wreck of matter, the crush of environment, the roars of disintegrating pent-up forces, as suddenly and blindingly confusing as a lightning stroke, absolutely and unutterably helpless, wherein no interval of time exists for the exercise of thought or protective measures, stark, staring horrors spring into being instantaneously and there bulges into this unprepared mental perception the absolute fear, awful dismay, and seeming inevitable certainty of immediate death. Here are overwhelming, ungovernable, and irresistible factors which cannot help being pregnant with psychic shock, with whatever human being is brought within their baneful effects. The writer maintains that the production of psychic shock under these conditions is not influenced by past experience, but can only be considered with the immediate and horrifying present. The longer the writer's experience in dealing with railway traumatisms, the greater becomes his admiration for the resistive powers existing in man, when age, health, activity, muscular vigor, and equanimity are his. The writer believes, with Carlyle, that "nature fashions no creature without implanting in it the strength needful for its action and duration." Man is only what he is, and must ever be a slave to effect; hence in the extremity where both passenger and employee for the time being bide, there will be produced in a normal human being, in spite of vocation or social state, results commensurate with his resistive powers. The vigorously developed, honest, healthy man, of calm disposition, whether passenger or employee, in the writer's experience, manifests the same relative degree of psycho-neurotic trouble after railway wrecks, and honest nature shows that these troubles are as infrequent in one as in the other. The writer has almost invariably found, when psycho-neuroses, or functional disturbances of the mind and nerves, follow after railway injuries, that predisposition, previous condition of health, the mal-effects of

showing that peculiar excitability present in psychic shock; the strong and energetic movements here were necessary to get some relief. We do not believe that psychic shocks in battle, cyclone, or railway wrecks are different in their manifestations, only in their surroundings. Probably if other psychic shocks were treated the same as those following railway wrecks, we would have the same results; but, inasmuch as Providence and nature cannot be sued, shock from cyclones and battles take their normal course uninfluenced by faulty suggestion and environment.

habits, and malingering, were generally the generic factors in their formation. We cannot agree with Bailey that railway locomotive engineers are more prone to hysteria and neurasthenia than other railway employees. Thus out of 2,501 railway injuries occurring to engineers, tabulated by the writer, he has seen only two cases of traumatic neurasthenia resulting from injury, and one of these had suffered for some time prior to the injury with albuminuria.

THE NECESSITY FOR CONSIDERING RAILWAY INJURIES GENERALLY IN THE PRODUCTION OF TRAUMATIC PSYCHO-NEUROSES, OR FUNCTIONAL DISTURBANCES OF THE MIND AND NERVES, IN ORDER THAT A CORRECT CONCLUSION MAY BE REACHED.

It is but natural to presume that in the consideration of any disease, the aggregate of all cases subject to this disease should be considered rather than the part, because if we consider only a part, we are not competent to form an opinion of the disease as a whole. Heretofore, in the consideration of psycho-neuroses following railway injuries, too much consideration has been given the passenger to the exclusion of the employee, trespasser, and citizen, and the writer holds that a broad and comprehensive conclusion can be reached only when all classes subject to these troubles are considered. When we study injuries to the passenger alone, we study a minor number of railway injuries. Thus out of 82,361 injuries tabulated by the writer, 3,293 passengers were injured, while 6,293 injuries occurred to trespassers and citizens, and 73,539 injuries occurred to employees; making over and above injuries to passengers, 79,068 injuries, or 24 times as many injuries to employees and others as to passengers alone, which heretofore would not have been considered. Again, if only the effects of collisions and derailments are considered, they, too, form only a part of injuries inflicted by the railway. We find that out of 75,864 injuries only 4,814 were occasioned through collisions and derailments, and 77,447 were from other sources. When the employees alone are studied regarding the occurrence of psycho-neuroses following railway injuries, the writer finds that among them it is so remarkably infrequent as to create marked attention and surprise among railway hospital department medical attendants.

The writer holds that the traumatic psycho-neuroses following railway traumatisms are of less frequent occurrence among railway employees than in almost any other vocation. We believe that of all the influencing factors in the prevention of ultimate effects, none is more potent, all things considered, than the age of the individual. The period of life between eighteen and forty years constantly offers over and above all other times of life, when no previous predisposition exists, the greatest resistive powers. This is a period of general vigor, cenesthesis, initiativeness and protective alertness, in which a person, when free from inherited predisposition, weakened condition at the time of the injury, or the debilitating effects of evil habits, rarely shows any ultimate effects. The railway vocation is a vocation of the young and muscular. Thus, for example, out of 66,962 injuries to employees, 53,975 were between the ages of 18 and 40, divided as follows: from 18 to 20 years, 1,528; from 20 to 30, 29,604; from 30 to 40, 22,974.

THE REAL FACTORS PREVENTING THE OCCURRENCE OF TRAUMATIC PSYCHO-NEUROSES, OR FUNCTIONAL DISTURBANCES OF THE MIND AND NERVES, AMONG RAILWAY EMPLOYEES.

The writer has been profoundly impressed with the fact, as years have come and gone, that medical authority has given little study and attention to railway traumatism among the employees. He believes it is demanded in the proper study of railway injuries where employees and others are concerned, that we consider influence of age, immediate surroundings of the injured employee during treatment, the influence of broad multiple suggestion, the importance of rest consequent upon confinement in bed for a more or less long interval of time, as well as the influence of the medical attendant, trained regarding the effects of suggestion, and too frequent examinations. These are generic elements, pronounced and powerful, both in the prevention and production of functional disorders of the nervous system following railway accidents as shown in the employee.

Aside from age, which is in itself a potent barrier to ulterior consequences, *cœteris paribus*, as stated before, the immediate surroundings of the injured employee in hospital and during treatment, are made to have a positive effect. This, along with mentally diversified elements aiming to prevent the injured person from indulging in pathologizing introspection, furthers the treatment of the medical attendant, trained to treat his patient with a knowledge of the dangers and benefits of suggestion: the mind of the patient, irritated in every direction, tends to morbidity. The constant consideration of the passenger to the exclusion of the employee has been, in our opinion, a most potent cause of many of the misleading views advanced by authors generally in the study of these troubles. It can be truthfully stated, and shown, that only one employee in 6,128¼ railway employees manifests anything like true psycho-neuroses, or functional disorders of the mind and nerves, after traumatism. The writer's experience forcibly indicates that there is, and must be, a consistent and positive influence for good where suggestion tends in a healthful direction, and where surroundings tend to mental diversion, and not to mental introspection and worry. Multiple suggestions constantly employed by agents with whom the injured person has for months and years been familiar, along with unsuggestive medical examinations, and normal social surroundings, certainly tend, at least with the injured railway employee, to get proper mental tone, thus leading the "instincts and subconscious mind-stuff to play healthfully and normally with mind and conduct." It is utterly impossible in the nature of man's mental make-up for any person to form a true and commensurate idea of the absolute force of suggestion in traumatized individuals. Hence, we hold that in all cases of severe injury there is a period of more or less profound mental shock, which at one particular time can be made to lead to a marked exaggeration of their mental impressionability, and the readiness with which they can be made to yield to suggestion. Who knows the power of suggestion, even in normal life? It exists above all analysis and estimate, but in the psychasthenic it stuns activity and throttles reason. It is claimed by Charcot that the psycho-neuroses are closely related to the hypnotic state, since in these conditions the presentment closely resembles the picture of a firmly rooted auto-suggestion. Clarke[1] says: "In traumatic hysterical paralysis following trauma the influence of suggestion can frequently be traced, as was first claimed by Charcot. He clearly pointed out the similarity between the symptoms of paralysis in the hypnotic state and those in traumatic hysteria, and considered that both were due to the influence of suggestion. In one case the action of the higher psychical centres is temporarily annulled by hypnotism, in the other by the influence of the nervous shock of an accident, which, by inducing a state of fright or terror, produces a similar effect. In this condition of suppression of the higher centres an injury to a limb may give rise to a kind of auto-suggestion, to paralysis, or instead of paralysis, to a spasmodic contraction of it."

---

[1] "Hysteria and Neurasthenia," by J. Michael Clarke, M.D. (Cantab.), F.R.C.P. John Lane, The Bodley Head, New York and London, 1905.

We will not enter into a discussion at this time of the mixed state of hysteria and neurasthenia, especially when arising from railway and allied injuries, but it is established that a combination of the two diseases is common, and that undoubted hysterical symptoms are found associated with neurasthenia. Furthermore, psychical stigmata may be present at one period and not at another. This instability in the symptom group seemingly depends upon the period when the patient is examined, or, as the writer conceives, upon the suggestive character of the medical examiner. In any event, the opinions given by different observers show constant discrepancy, particularly in traumatic cases. In the examination of the psycho-neuroses arising from railway injuries, it is found that certain symptoms of hysteria and neurasthenia are common to both; viz.: mental confusion, amnesia or failure of memory, headache, insomnia, muscular weakness, vertigo, easy fatigue on exertion, pains in back and limbs, various paræsthesiæ, dyspepsia, anorexia, and, at times, vomiting.

The writer trusts that no one will impute to him captious, impudent, unjust, or disrespectful motives when he says that should the neurologist or a medical attendant of neurological training be put in charge of the hospital and hospital department over which he presides, in which only railway employees are treated, there would be a great many cases of ulterior nerve effects where we now have one.

If any medical attendant follows out the examination, treatment, and the methods inculcated and practised by neurologists, the writer believes that the effect would be immediate and positive. He believes it can be shown at a certain period in all severe railway injuries to the employee, that he is as susceptible as the passenger or other person to the potent influences of dignified, impressive, and convincing suggestion engendered by the neurological process of examination. Further, in all severe injuries to employees there is generally long confinement in bed. Here the best element of rest as a cure is obtained. When an injured employee in our hospital begins to show too much mental introspection, or manifests psychoses or mental morbid states incomprehensible and foolish to his fellow-patients, they are taught to make light of every complaint, and by various ways divert the injured employee's thoughts. We do not assert that our opinions are absolutely correct, but we do say that, when we can show that out of 73,539 injuries to employees we only find 12 real cases of psycho-neuroses following these injuries, there is some plausible reason for the same. If, then, only one employee in 6,128¼ injured by the railway has functional disorders of the mind and nerves, there must be protective elements of age, health, muscular vigor, psychic tone, normal surroundings, together with positive therapeutic aid engendered by immediate medical care and suggestion, tending in a healthful direction, as well as the negative unsuggestive medical attention.

Although traumatic psycho-neuroses, or functional disturbances of the mind and nerves, may arise from any accident in which injury and shock are factors, yet the writer will only discuss in this article those relating to railway traumatisms, since the accumulated data he has at command have only been taken from this source. There are three forms of traumatic psycho-neuroses, or functional disturbances of the mind and nerves, arising from railway injury. These are now generally accepted and described. First, those of a neurasthenic type; second, those of an hysterical type; third, traumatic psycho-neuroses of the grave type, defined by Hamilton as "an alleged condition, the outgrowth of one or both of neurasthenic and hysterical type, and practically an incurable disease."

As a matter of convenience for both writer and reader in treating the causative factors of traumatic psycho-neuroses, it is best to consider the neurasthenic type and hysterical type together up to a certain point, since the etiology of these two types is in many essentials the same.

As before stated, traumatic psycho-neuroses arising from railway injuries may follow from any source wherein there are shock, fright, concussion, and strain. In describing the causes, or manner of infliction, of railway injuries, the writer believes that it will be proper and distinctive at this time to speak of the peculiarities of kinetic energy evolved in their production, and the relative power of this energy in begetting injury and psychical effects.

To enable the reader to comprehend more readily the inherent intensity of these energies and their likelihood of begetting these effects, the following is the scheme: The writer has in a previous chapter endeavored to explain his reasons for the nomenclature and classification of the causative factors of railway injuries. He sees no reason why technical terms should not be used in their classification and description if such terms will convey to the mind in a short and precise way the character and manner of forces or energy manifest in their production. As stated before, all railway accidents are resultants of kinetic energy or energy in motion. The classification which here follows takes into consideration the kinesic states assumed by the injured individual and not those of the mechanical agent. By so doing it will be seen that a comprehensive classification has been reached. The four headings used in classifying railway injuries aim to indicate the different manifestations of kinetic energy, or energy in motion producing these accidents. 1st. The kinetic-kinesic accident. 2d. The bi-kinetic. 3d. The mono-kinesic. 4th. The un-kinesic. The kinetic-kinesic accident is wholly vehicular in character, where the person or persons injured are on trains, cars, etc., while in kinetic energy and the incident disintegration or interference with train, cars, etc., transfers part of the force in this kinesic train to the individual injured, as in collisions, derailments, backing up of trains, jerking of trains, parting or breaking in two of trains, and switching of trains. This form of accident is the most productive in begetting traumatic psycho-neuroses, owing to the fact of suddenness of occurrence, the more or less constant occurrence of horrifying circumstance. In the bi-kinesic accident both mechanical agent (trains, etc.) and the injured individual are successively in kinesic states, the mechanical agent being primarily in kinetic energy, and gravity imparting aditional kinetic energy to the individual in the process of injury, as, for example, in falling from trains in motion, jumping upon or from moving trains, being struck while on moving trains by bridges, trestles, switch-stands, mail-cranes, etc. The writer has already referred to the mental influence produced upon man by kinesic surroundings, or trains in more or less rapid movement, and there is no doubt that in the majority of men kinesic influences are positive, both in placating the mind and giving rise to sudden and overmastering suggestions and impulses. In falling from moving trains kinetic energy is the power which rules the actions of the individuals without regulating the will. Owing to this helpless mental state and the intensity of kinesic energies evolved, it will be found that falling from moving trains is the most fatal form of accident occurring to the passenger. Bi-kinesic accidents are invariably severe, and traumatic psycho-neuroses are very infrequent in this form of accident. In the mono-kinesic form of accident the injured individual from some cause goes into kinetic energy, mainly through the influence of gravity, sudden attacks of syncope, etc., as in falling from standing trains, etc., falling from bridges, trestles, telegraph poles, falling into pits and cattle-guards, falling because of unstable footing, such as icy ground, etc. This is the least fatal form of accident, as a general thing, occurring upon railways. The un-kinesic accident is where the injured individual is in a more or less quiescent state while the mechanical agent is in kinetic energy. We have already stated the conditions under which this occurs. Here, again, this form of accident may arise from neurasthenic impulsions, since under this heading no less than thirty-four persons committed suicide by throwing themselves on the track or getting before approaching trains.

This part of our subject, relating to kinetic energy, is given to demonstrate that in making a diagnosis of traumatic psycho-neuroses it is of importance to have presented in a conspicuous way the action of these energies, and to have the quality of force and energy designated.

In the writer's experience, force as a factor has been too lightly considered, and if the medical attendant desires to be conscientious and dutiful, he can do this only by a thorough study of the intensity of force involved, as well as by deep study of attendant elements of horrifying circumstances, since these two elements are the makers of psychic shock.

That a passenger has been in a collision or derailment is generally considered by the average medical attendant to be sufficient cause for any symptom complex that may manifest itself in traumatic psycho-neuroses, although it can be demonstrated that many collisions and derailments never disturb the occupants of rear Pullman cars. In many instances the occupants of these cars are not aware that a collision or derailment has taken place until they have been so informed. Hence factors of psychic shock cannot possibly have been present. The location of the passenger in the collided or derailed train is of decided importance, since it enables the medical attendant to estimate the force and the character of disturbance likely to have occurred in these accidents, and whether it be horrifying or not. Again, it is necessary to consider whether it be a head-on or tail-end collision. If head-end, the front cars are always affected, while the rear cars are not likely to be so much affected. The reverse condition appertains to tail-end collisions. Here the rear cars are affected in a more or less excessive degree, and not the front ones.

The elastic buffers in vestibule trains have been constantly found to reduce the influence of mechanical concussion exerted on trains in collision or derailment to a minimum. These, in connection with the automatic air-brake, are pronounced in the destruction of ulterior consequences engendered by the mechanical disintegration of kinetic energy existing in fast-moving trains.

Again, traumatic psycho-neuroses rarely occur in persons under 20 years of age. It is established that the most fertile period of life for the production of traumatic psycho-neuroses is between 20 and 40 years. This is the most active period of life, and this holds good in all of the manifestations of acute troubles as well. In 82,361 railway injuries 60,706 victims were between the ages of 20 and 40. As far as the employee is concerned, more injury cases occur between 30 and 40 because the greater number of employees are between these ages.[1]

---

[1] Out of 82,361 tabulated the following were the ages of the injured: Under 20 years, 3,711; from 20 to 30 years, 31,590; from 30 to 40 years, 29,116; from 40 to 50 years, 9,688; from 50 to 60 years, 3,683; over 60 years, 1,282; unknown, 3,291.

PREDISPOSITION.

It is generally conceded that among the important factors in the production of a large proportion of genuine cases of traumatic psycho-neuroses, none occupy a more important place than neurotic heredity and previous ill health. Our experience indicates that the hysterical type is more frequent among employees than the neurasthenic tpye, particularly where there are inherited conditions. Thus it is demonstrated that out of eight cases of psycho-neuroses among employees, all of them had either inherited hysteria or a previously acquired hysteria; while among the passengers, out of 36 cases of traumatic psycho-neuroses, 6 were of the inherited hysterical type, or had hysteria prior to accident. In three cases among employees alcoholism and luetic evidences were manifest. One had albuminuria, which had existed several years prior to the accident. Among the passengers, financial and social worry could be demonstrated in five.

It has been asserted that railway-train employees are predisposed to traumatic psycho-neuroses on account of the irritation of the nerve centres from continued vibration. The truth of this assertion has never been demonstrated. In the writer's experience, the engineer is not more prone to traumatic psycho-neuroses than his fellow train employees, since only one-sixth of the cases of traumatic psycho-neuroses among railway employees were in engineers. The fact that railway postal clerks are apparently more prone to traumatic psycho-neuroses than others employed upon passenger trains, the writer believes can be plausibly explained as follows: a postal clerk is in the same relation to the railway as a passenger, and travels in the same portion of train where railway baggagemen and railway expressmen are carried, yet experience shows that these men are not prone to this trouble. The postal clerk is paid by the government for the time he loses after injury, he is generally insured in accident companies, and can sue the railway company for damages inflicted without losing his position. It is one of the peculiarities in the production of traumatic psycho-neuroses that when financial rewards are promising cases are frequent.

INFLUENCE OF SUGGESTIVE SURROUNDINGS—VOCATION.

In the production of traumatic psycho-neuroses, or functional disturbances of the mind and nerves, it is accepted as true that where there is no serious bodily injury, the morbid mind predominates the nervous condition following shock; hence these disturbances cannot be due to physical causes. The writer, in the light of past experience, is firmly convinced that the mental condition of the individual prior to the accident is an important determining factor in the production of traumatic psycho-neuroses. An equally important factor in the production of these troubles is the previous education of the injured person or persons as to the possibilities in litigation. There is no doubt that the mental poise engrafted upon persons by the nature and condition of success and necessities in their business is an influencing factor. It is an established fact that wrecks of suburban trains are followed by traumatic psycho-neuroses more frequently than are those occurring at more remote points. Out of 242 injuries to passengers occurring upon suburban trains, 15 cases of psycho-neuroses of the neurasthenic and hysterical types were claimed to have occurred; while in wrecks occurring at remote points, 1,841 passengers were injured and only 18 cases were produced. Again, the influence of distinctive and special communities or cities appears to have a positive effect in this direction, at least in litigation, possibly not in the production of genuine cases. It is claimed that Philadelphia and St. Louis are less given to the consideration of these troubles than Chicago and New York. There can be no doubt that persons engaged in pursuits reasonably successful and not educated in the wiles of life are less prone to psycho-neuroses than those oppositely situated. Thus in a railway excursion to the St. Louis World's Fair, the passengers of which were composed entirely of farmers, the train suffered wreck, 64 passengers were killed and injured, and only one case of traumatic psycho-neurosis was presented, and this was of an hysterical type, which did not improve after settlement.

Where honest men, filled with the zest of life, possessing muscle and vigor, and with the pleasure of recompense added to their labors, are brought within the influence of wrecks, they are not prone to think of or manifest traumatic psycho-neuroses unless really existing; and unless suggestion should have its effect at the critical point, they are not likely to develop it. Prosperous conditions are not productive of traumatic psycho-neuroses, where no inherited tendency exists. It is natural to suppose that in the production of traumatic psycho-neuroses there would be a greater number of cases in years when panic prevailed than in times of general prosperity, since the mental state of the injured individual prior to the injury is so constantly demonstrated to be a determining factor.

STATUS OF PERSON OR PERSONS AT TIME OF ACCIDENT.

It is well attested and recognized that railway accidents occurring when injured individuals are asleep, are less productive of traumatic psycho-neuroses than when the individuals are awake and susceptible of terrifying influences. It is an established fact that intoxicated persons are not affected in the face of threatened severe injury. Hence, it is not at all surprising that intoxicated persons are not prone to the development of traumatic psycho-neuroses. The writer freely acknowledges that he is constantly confused when he reads in the works of many authors upon this subject the countless assertions made that the elements of fright and psychic shock are less in railway employees than in persons who are accustomed to travel a great deal. The writer maintains that it is constantly demonstrated that no one, be he employee or constant traveller, can be rendered immune from fright and psychic shock when facing seeming sudden and inevitable death. The influencing elements in every severe collision or derailment and allied accidents are the occurrence of immediate actual presence of instantaneous, unanticipated, and unwarned engendering of horrifying circumstances, wherein almost complete and supreme subversion of normal surroundings envelop the exposed person or persons. The absolute suddenness of occurrence, the unceasingly horrifying acute condition, with no interval for thought or protective procedure, beget positive elements of fright and psychic shock. The fell power of a horrifying presence and the absolute facing of death, which no amount of experience can eliminate, and the degree of effect from great intensity of force make these accidents productive of all the degrees of this emotion as expressed by the words "fear," "terror," and "consternation." It is true that now and then engineers and firemen may in some particular collision or derailment see and anticipate the coming danger, as position favors it, and may thus be enabled to jump from their engines and avoid approaching danger. These instances certainly lessen psychic shock. But it is not so with other train employees, such as conductors, baggagemen, train express agents, railway postal clerks, brakemen, and train porters, who find themselves in the same position as passengers in the midst of structural disintegration, unanticipated and unwarned, facing absolute annihilation. Hence, no amount of familiarity with dangerous surroundings has anything to do with lessening psychic shock in the employees in collisions, derailments, and allied injuries.

In any other accident this familiarity has an effect, such as repetition in previous experiences illustrated in jumping from moving trains and other immediate accidents. It is plainly a matter of psychical health, vigor, and stamina which minimizes the effect of psychic shock; and the healthy, vigorous, honest passenger shows the same resistance and recuperative powers that are shown by the employee.

The wards of railway hospitals constantly show the deep psychic shock manifested among railway employees after severe wrecks; the sighing and muttering of injured railway employees in sleep, the cries of alarm, the sudden jumping up in bed, panting and gasping in fright and excitement, along with other evidences, are constantly seen. Again, gracious nature puts a limit in almost every instance to continued psychic horror, as a period of unconsciousness of more or less long duration is almost constantly manifest in persons exposed to wrecks. This, we believe, in the healthy, young, and vigorous, as well as in the weak, is nature's safeguard and preventive to the baneful influence of profound psychic shock following these wrecks.

The writer has found, when examining persons who have undergone the horrifying experience of a wreck, and heard them detail their experience as to what they have seen, heard, and felt, that almost invariably such expressions as these are used: "I did not know anything until I found myself in this or that place;" or, "I did not know anything until I found this or that person helping me;" or, "All became a blank; afterward I found myself crawling out of a coach window, door, or upon a bank," plainly showing that an interval of unconsciousness or complete mental obscuration has ensued. Bailey says: "The circumstances of the patient's injury exert most important influences. If, as in cases of railway employees, it is imperative that the individual resume his work at the earliest possible moment, he generally does so, although still suffering from the effects of the shaking up and shock he has received. The return to work implies an attention to necessary routine which prevents him from continued observation of his own symptoms."

This is not so upon railways which have hospital departments, since the injured employee is immediately carried to the nearest company hospital. He has contributed to sustain these hospitals and he knows he is entitled to treatment, hence expense here is eliminated.

A thrifty railway employee generally insures himself against accident in some accident insurance company; he is almost invariably a member of some protective labor organization; additionally, he knows that he will receive fair compensation from the railway company for damage inflicted. Here, then, is no imperative necessity which compels him to go to work while he is still suffering from the effects of the shaking up and shock. The writer's experience shows that in the case of railway employees working upon roads having hospital departments, the patient almost always indicates the degree of injury inflicted, and manifests a desire to resume labor because he feels that he is able, and not because there is any imperative necessity.

THE NEURASTHENIC TYPE.

The neurasthenic type of traumatic psycho-neuroses arising from railway injuries is essentially the same as neurasthenia arising from any other source, with the added element of fright, shock, concussion, and strain, producing an increase of pain in the back. A larger amount of pain existing in the back is the most conspicuous difference between neurasthenia and that of the neurasthenic type arising from railway accidents. Neurasthenia may be defined as a condition particularized by a more or less markedly persistent state of fatigue and irritability of the central nervous system, wherein causes which would not affect the normal individual become exaggeratively operative in the neurasthenic. It is generally considered that heredity is the foremost of all predisposing factors, and that constitutional disturbances arising from railway injuries as well as other sources should be viewed more as a provocative element than as inherent predisposing factors.

Hamilton[1] says, "The neurasthenia of to-day is therefore a disease of the ill-prepared and badly organized, who are liable to go under through the operation of causes that would certainly not have much effect upon the stable and normal individual." The origins of neurasthenia are extremely numerous, any cause leading or tending to debility of the system produces neurasthenia. Mental overwork, acute illness, such as typhoid fever, malaria, and influenza; the excessive use of tea, coffee, and tobacco, sexual excesses, as well as sexual abstinence, masturbation, and unnatural means of sexual gratification, produce neurasthenia. Everything tending toward exhaustion of the nervous system will cause it; thus, organic trouble, such as gout, diabetes, syphilis, albuminuria, and toxæmias from a variety of troubles. Again, it is found associated with other functional troubles, such as hysteria, hypochondriasis, etc.

The true status of trauma, or railway injuries, in the production of neurasthenia, is so constantly enshrouded by a multitude of possibilities and probabilities that there is doubt as to its being at any time an only and absolute cause; that it is a provocative agent has not been denied.

When any or all the causes above enumerated are operative in the individual at the time of injury, or when many mental states, debilitating surroundings, insidious undermining social worries exist, it places the demonstration of trauma as an absolute cause among the difficult things to prove, and among the least potent agents in its production. Most of the symptoms being subjective, the diagnosis is rendered difficult. The honest passenger or employee is always a knowable quantity, but the dishonest claimant demands a most careful and exacting analysis of symptoms to determine that trauma has been the cause. Anything exhausting the nervous system tends to produce neurasthenia; this creates a brood of causes which constitute a greater part of the life history of man, and if quick reaction to changing conditions were lacking, or health failed to counterbalance nervousness, nervous weakness or nervous irritability, then civilized man would indeed be in danger of becoming a weak inanity.

---

[1] *Loc. cit.*

The two most prominent symptoms of neurasthenia are nervous weakness and nervous irritability, that is, a general condition of nervousness. The words "nervous" and "nervousness," so commonly used in the description of neurasthenia, Clark claims, are of such vague and indefinite meaning as not to admit of any exact definition. Foster[1] says: "Nervousness is excessive excitability of a nervous system especially manifested by a proneness to mental excitement and over-sensitiveness to sensory impressions. The condition sometimes borders on hysteria and insanity." Hence, nervousness in man is manifested by a proneness to mental excitement and over-sensitiveness to sensory impressions, or a tendency to psychical excitement at the most trivial causes, such as would not affect the normal individual.

In nervousness we recognize a want of resistance, incapacity for continuous effort, and the early occurrence of exhaustion after mental effort.

From these reasons comes the impossibility of drawing a correct line of demarcation between those persons who are excessively nervous but still within the limits of health, and those who have passed from this excessively nervous state to one of a pathological character.

Again, it is for these reasons that the term "neurasthenia," as claimed by Bailey,[2] may convey different meanings to different individuals, and will justify Defendorf[3] in saying that the diagnosis of traumatic psycho-neuroses is not only difficult but sometimes impossible. The results in practice, as the writer has often observed, indicate that the diagnosis of the neurasthenic type of traumatic psycho-neuroses is made with astonishing ease and celerity. All that it needs is the fact that a person has been in a railway collision, etc., no matter if every element which makes psychic shock and injury be absent; if the supposed injured person complains of general weakness, and the presence of an abnormal reflex is demonstrated, the case is diagnosticated as traumatic neurasthenia. It is almost as easy to make this diagnosis as it is those of which Dana speaks, in illustration of which he cites the case of a visiting American consulting a European professor, who makes a diagnosis as the patient is announced.[1]

---

[1] Foster's "Encyclopedic Medical Dictionary," D. Appleton & Co., New York, 1893.

[2] *Loc. cit.*

[3] "Clinical Psychiatry," A. R. Defendorf, p. 375. Macmillan Company, New York, 1902.

PATHOLOGY.

Much speculation has been indulged in regarding the pathology of the neurasthenic type, but nothing has been determined, hence there is no adequate explanation regarding the pathology of this trouble.

SYMPTOMS.

Variability in the appearance of symptoms in the neurasthenic type of traumatic psycho-neuroses is one peculiarity of this trouble. The symptoms develop gradually, sometimes taking weeks and months after the shock and injury; although where injury is slight, but excessive fright and pronounced emotional disturbances are manifest, the periods of nervousness may show even the next day and gradually increase in intensity until treatment is absolutely demanded. Should the injured individual, as the case progresses in intensity, be induced to consult an attorney, the thoughts and worries incident to litigation still more intensify this trouble. While the most constant series of phenomena in a neurasthenic type resemble those of neurasthenia with the added effects of injury and shock, yet symptoms of the neurasthenic type are very far from being always alike; still they resemble, in a great many elements, not only one another, but, as before stated, neurasthenic states arising from other causes.

The condition of the injured person immediately after the accident shows more or less pronounced evidence of severe shock; *e.g.*, there are the pallid skin, the dry fauces, the dazed look, the clammy skin, complaints of dizziness and faintness, frequently followed by gagging and vomiting. When psychic shock has been pronounced, though the injury be trivial, or where horrifying circumstance has been acute, it is rare for any one after collision or derailment, if he has been thrown in various positions by the tumbling or breaking up of coaches, to be unaffected by unconsciousness. We believe that any person passing through exceedingly horrifying circumstances and remaining conscious at all times, will certainly suffer grave psychical effects. Not one person in a hundred is perfectly conscious through all phases of rapidly acting horrifying catastrophe. Almost invariably there will be a period in which he knew nothing until such and such a time or until he found himself free in such and such a position. It is, we believe, natural to become unconscious when in the presence of rapidly occurring catastrophe. It is equally unnatural not to be so. It is difficult to say that one who has suffered an injury to the head of sufficient force to knock him down, is free from unconsciousness—it may be momentary, still consciousness has been impaired. Concussive blows upon the jaws and neck, and even the body, have, in my knowledge of railway wrecks, produced a more or less long period of unconsciousness. Mental confusion is constant where kinesis sways the injured individual in the confines of a disintegrating railway coach. We have known cases in which an inverted position (that is, where the person was suspended head downward in an overturned coach) has caused unconsciousness for a half hour or more, and upon examination no injury was apparent, but nausea and vomiting occurred, followed by a weak, nervous, trembling condition lasting many hours afterward. In most accidents the injured individual is generally able to walk around, or place himself in position where necessary aid and care may be obtained. Doubtless, the suggestive influence surrounding wrecks has a positive effect upon the action of those affected. Any one who has seen a railway wreck would not have failed to notice the positive restlessness which seizes the participants. Thus, after all the injured have been attended to, there generally comes an interval in which the wrecked passengers have to wait until arrangements are made to ship them to their destination. In this interval of wait there is a ceaseless change of position among these persons; they wander around, sit down for a moment, then rise, move their arms and legs, click their fingers upon their thumbs, then inhale and exhale boisterously, only to repeat the procedure.

---

[1] *Loc. cit.*

MENTAL STATES.

The most common causes of traumatic psycho-neuroses, or functional disturbances of mind and nerves, of the neurasthenic type, are those in which patients complain of an inability to do their daily work as they had done prior to the injury. Any sustained mental effort becomes almost impossible, owing to the fact that it brings on headache, mental discomfort, and seeming utter inability to think. The patient repeatedly tries to resume work only to find that the attempt terminates in confusion and inability; the least effort ends in confusing turmoil; little difficulties and petty worries irritate and undo the patient completely. The slightest noise or disturbance begets extreme and foolish vexation, and thoughts thereof rob him of sleep. His sleep is uneasy and discomposed; he wakes up in the morning unrefreshed by his night's rest. In the neurasthenic type, as well as in all forms of neurasthenia, mental depression is a common endowment, and, like most of the symptoms of neurasthenia, is invariably worse in the morning, gradually becoming better toward evening, with constant headaches, defined in character, generally affecting the forehead or back of the neck. With this confusion there are unpleasant sensations in the head, such as though a constricting band was about the head, marked sensitiveness of the scalp, then burning sensations; again, sensations of chill, or a feeling as though the head was opening and shutting, are present. The almost constant presence of pain in the back is always aggravated by exertion, particularly in walking. At times, while resting in bed, there is more or less absence of pain. All of these aches, pains, and sensations, coupled with mental inability, make the patient's thoughts languidly and irritatingly lead to sombre conclusions, a dismal view of life, making everything become a burden. Hence, it can be readily seen why sufferers from neurasthenia may think of suicide, but the same indecision which prevents accomplishment in other ways has its effect here; they may think of suicide, but the effort is lacking, they do not attempt the same.

Clarke[1] says: "They are rarely suicidal, and when a patient has become distinctly suicidal it may be assumed that the mental depression has gone beyond neurasthenia." Loss of will power is shown by the inability upon the part of the patient to decide what course to pursue in the most common and ordinary actions of life. Indecision has now become as seemingly constant as decision was in health. Oblivious at all times to their interests and belongings, they have no thought for anything outside of their many ill feelings and perverted sensations. Sensitive to irritation, noise throws them into unbearable excitement; at times light becomes irritating, hence the patient stays in a darkened room or stays for hours at a time in absolute darkness. Soon he can tolerate no talking and only communes with himself. Increased emotional irritability may become manifest, so that without cause or reason he bursts into fits of weeping. Then there comes a more or less constant feeling of apprehension—the fear that something may happen; morbid fears are a constant and characteristic feature in neurasthenia, as well as in the neurasthenic type. At times these fears are connected with the circumstances of the injury, hence these persons dread and fear railway travel, or anything suggesting the danger of motion. They dread crossing open spaces when alone, though this fear may be allayed by the most trivial agent, such as some one walking behind or a child leading. It is considered by some that with patients having vertigo the dread and fear to go out of the house on to the street comes from the dread of falling down in attacks of vertigo. Again, they have fears of a crowd, fears of cramped space, fears of sudden death, of syphilis, of being crazy, of heart disease, and a variety of others. Attacks of vertigo have an important bearing in these cases, if they are in any manner severe, since they impress the patient with the idea of being very ill. Attacks of vertigo are most likely to come on when the patient starts out from the house to take a walk, hence are frequently the cause of the patient staying indoors.

---

[1] *Loc. cit.*

It rarely happens that these patients injure themselves by falling when seized with attacks of vertigo. Again, in several attacks of vertigo there are more or less pallor, dimness of vision, and, at times, ringing in the ears, or *tinnitus aurium.* At times gastro-intestinal derangement seems coincident with vertigo. The variable phases and conditions of insomnia have a wide influence, particularly in the mental depressions and fears of various kinds; additionally, disorders which precede sleep plainly influence, in a more or less profound degree, the intensity of insomnia. In periods preceding sleep, unreasonable and senseless anxiety and worry may come on, thus that the front door is not locked, or the gas is turned on, or any apprehension of varying and nagging intensity. Patients most frequently and bitterly complain of insomnia and disordered sleep, and while it may occur that the patients sleep sufficiently long, still they are as unrefreshed in the morning as though they had had no sleep. As the patient's general nervousness increases, disorders of sensation manifest themselves in proportion to the day's worry and fatigue. At times, just as the patient is getting to sleep, a sudden start or jerk of the whole body occurs; these jerks may be so intense as to throw the whole body violently upward in bed. He may have sensations as though being struck upon the head; or loud noises, like the explosion of firearms, may be heard; or flashes of light may be seen; or a magnified sense of odor may be present. When such shocks as these are severe and intense, the fear of a recurrence frequently prevents sleep.

Motor Disturbances.

In cases of the neurasthenic type of traumatic psychoneuroses, general loss of power, or muscular debility, with extreme and rapid fatigue upon exertion, are among the most constant and important motor disturbances. How much of these disturbances may be due to inanition of the nerve cells depending upon deficient nutrition, how much to an accumulation of the waste products of the body causing auto-intoxication, and how much to the excitation of the cerebral cortex is speculative. "Undoubtedly there are cases in which the varying action to fear of exertion interferes with the excretion of waste body products, that the retention of toxins acts injuriously in this way."[1] This muscular debility and consequent fatigue affect all parts of the body; any muscular exertion induces ready fatigue. Muscular feebleness predominates in the legs in a great majority of cases, and is associated with pains and weakness in the back. Among uncommon and rare motor disturbances is a feeling of stiffness in the limbs which comes on suddenly when attempts at rapid movement are made; it partakes of the character of cramps. Again, as stated by Weir Mitchell,[2] it may occur after waking from sleep. Some patients find difficulty in standing on one leg, or when the feet are brought together with the eyes closed, but it is rare to have this manifestation occur in a very marked degree. These are in no manner like true ataxia of gait or movement. Hamilton maintains that in neurasthenia there is never what may be called true paralysis, and even in the occasional rare cases in which the will has been suspended for a long time the apparent lifelessness and rigidity of the extremities are, after all, ideational paralysis, which is curable.

---

[1] Allan McLane Hamilton, *loco citato.*

[2] "Clinical Lessons on Nervous Diseases," 1897.

MUSCULAR TREMOR.

Dercum is of the opinion that muscular tremor is absent in the majority of cases of ordinary neurasthenia, and that it is more often seen in the neurasthenic type arising from railway injuries when the elements of trauma and emotional excitement are pronounced. The tremor in this type takes a fine and rapid form and should be carefully studied so as to exclude tremors arising from alcohol and other causes. These tremors are not constant; they may be present in some cases and absent in others. Fibrillary twitchings of the muscles of the tongue, eyelids, rarely of the lips, and small muscles of the hand may occur in one muscle or in a group; now and then a whole extremity, as a leg or an arm, is affected. It is only after exercise that these fibrillary twitchings come on, as when the patient rests or goes to bed. They do not come on at times of exercise or interfere with movement.

REFLEXES.

Concerning the reflexes in the neurasthenic type, there exist pronounced differences of opinion as to their true value. It has been shown that when the patellar tendon is struck in one instance the patient gives an immediate and pronounced start or jump, indicating decided and positive effect for a more or less short interval of time, while another person being struck on the patellar tendon gives no evidence of knee-jerk. In these latter cases Dercum[1] claims that we should at once look out for organic trouble, but the writer's experience sustains Hamilton[2] in the assertion that in a small proportion of perfectly healthy persons it is impossible to evoke the knee-jerk at all. It is generally claimed that the deep reflexes are almost invariably exaggerated and the superficial active. Bailey claims that the superficial and deep reflexes in the neurasthenic type are never diminished; they are either exaggerated or normal. Again, Hamilton concludes that "the reflexes are of little importance in neurasthenic states. In these as well as other affections in which the cerebral inhibitory powers are diminished, the deep reflexes are more or less exaggerated, and, in hysteria particularly, to a conspicuous degree. Although unilateral exaggeration may be found and is regarded usually as a symptom of central disease, I have found it once or twice in cases of this kind in which there was clearly no degeneration as a phenomenon."

---

[1] "Nervous Diseases, by American Authors," edited by Francis X. Dercum. Lea Bros. & Co., Philadelphia, 1895.

[2] *Loc. cit.*

Knapp[1] says that "reflexes never differ on the two sides."

Sensory Disturbances.

All men are born with means for bearing any pain, and there is hardly a man who has not inherited a tendency to some dominant pain to which the others are subordinate; but in the neurasthenic type, as in all neurasthenia, as well as in the great bulk of mankind, pain in the head and back are commonly complained of. Though pain in the head, or headache, is the most common of all abnormal sensations, in this type it has at least the redeeming element that while more or less constant, it is worse in the morning on getting up, and better toward night.

Among the frequent sensations complained of in the head is the sense of weight and constriction, as though a helmet was on the head, called by Charcot "*casque neurasthénique.*" Another frequently occurring sensation is the dull aching pain in the occipital region, or base of the brain, and then, pain in the frontal region. In addition to this, we have pain on both sides of the head in the temporal region. These headaches are more or less paroxysmal, and any attempt at mental exertion either aggravates them or brings on the dull, heavy, aching pain in the occipital region, that is, pain at the base of the brain. Sensations in the head, such as of confusion, dizziness, vibration, or of a throbbing character, are more or less frequent. Along with this comes hyperæsthesia over the seat of pain. This is not constant in character. Sensory disturbances in the neurasthenic type are subjective. As stated before, the principal difference is a decided prominence of pain in the back, extending up to the head and other parts of the body, but generally the chief seat of pain is in the lumbar region; it may sometimes extend up to the shoulders and even higher.

---

[1] "On Nervous Diseases, by American Authors," p. 155.

Spots of tenderness, without any definite cause, are constantly met. The intensity of pain in the back is seemingly dependent upon the extent of nervousness manifested in the individual, and at times has a tendency to shoot all over the body. These pains in the back may be dull, darting, or shooting, and often peculiar, as the picturesque language of the patient makes them. Again, pains in the back manifest their presence with extreme irregularity, not only differing on different days of examination, but even differing at consecutive examinations. The patients are extremely irritable and uncertain.

Daily examinations have disclosed to the writer that it is extremely rare to find pain in the back having any regularity as to precise location, so much so that to the uninformed it would suggest malingering.

It is claimed by Dana[1] that there is a good deal of tenderness along the spine in from 60 to 75 per cent. of all cases. The manner of asking as to the presence of pain, as in the writer's examination, has positive influence, thus: "I know that you do not have pain here, when did it stop?" "What, the pain has stopped here?" etc. In spite of existing mental confusion, they maintain its non-existence at this or that point. We believe that the preconceived and the predetermined mental state of the medical examiner has a decided influence, particularly when so-called instruments of precision are used. Nothing impresses a weak or non-resisting mind more than do these. We have seen prods and pricks applied to the back of a neurasthenic that would render a perfectly healthy person nervous and uncertain. Hamilton[2] asserts that, "while the patient may complain of deep pain in the back, yet there is ordinarily superficial hyperæsthesia. It is the general opinion that anæsthesia cannot exist as such in any form of neurasthenia. Pertinent to this is the assertion of Dana[3] that "this diminished sensibility or anæsthesia is, however, one I have never been able satisfactorily to demonstrate in any except patients who presented distinct hysterical marks of other kinds, or in cases of organic neuroses, and the difficulties in the way of establishing a diminished sensibility which may be considered pathological are so great that the symptom is, in my opinion, even at present, of but little importance."

---

[1] Charles A. Dana in "A System of Legal Medicine," edited by Allan McLane Hamilton, 1894, established the fact that up to 1894 there had been written 278 books and articles treating of traumatic neuroses (vol. ii., p. 301).

[2] *Loc. cit.*

[3] *Loc. cit.*

Paræsthesias, such as a sense of numbness or tickling, prickling, as of pins or needles, generally in the feet and legs, and not often occurring in the hands and arms, are very common in the neurasthenic type, as well as in neurasthenia. Some of the patients complain of uneasy or painful sensations, associated with the action of the heart. Extreme nervousness produces sensations connected with the stomach, intestines, and also vague, depressing sensations of the thorax and abdomen. There also exists extreme sensitiveness to the effects of heat and cold; no matter what is done, it seems impossible to warm the patient up in bed even in weather not excessively chilly.

Disturbances of the Special Senses—Eyes.

We have already spoken of the marked sensitiveness to light, which causes the patient to live in a darkened room, or spend his evening hours in absolute darkness. This photophobia can occur only in severe cases. Asthenopia, or weakness of sight, is a common symptom. The eyes soon tire; persistent fixation of the eyes, as in attempt at reading, or investigating something with the eyesight, causes indistinctness of vision, blurring of sight followed by shooting or burning pains in the eyeball; as would be naturally expected, this alone, or with the general weakness and irritability, prevents the patient from indulging in reading for any length of time. It appears that in the production of neurasthenia, or in the neurasthenic type of psychoneuroses, manifested inherited and natural defects become more or less exaggerated, and this holds true when errors of refraction, especially hypermetropia and astigmatism, are present. It is considered that contraction of the visual field is not an evidence of neurasthenia, nor is it with the neurasthenic type. It would seem that when indistinctness of vision occurs, it arises from fatigue. It is known that when the vision becomes indistinct from concentration and incidental fatigue, the indistinctness appears first upon the periphery of the field, and in some cases when an object is moved from the periphery toward the centre of the field, it can be seen farther from the central point than when moved from the centre toward the periphery, that is, directly opposite to the normal. This is known as Foerster's, or the shifting, type.

Hearing, Taste, Smell.

It can be stated with truth that the general condition called "excessive nervousness" influences the special senses in various degrees. In the neurasthenic type, the patient, at times, cannot bear to hear any talking, he becomes hypersensitive to the sound of music, etc., as well as to the most trivial every-day sound. Any pre-existing ear trouble may become very annoying, but the neurasthenic type is not productive of any ear trouble.

Disturbances of the Heart and Circulation.

It is claimed that from one-half to two-thirds of all the cases of the neurasthenic type of psycho-neuroses have cardiac irritability, and this is particularly so when emotional disturbances are present. Among such disturbances is the effect of personal examination by the medical attendant. It is claimed by some writers that in the majority of the cases the pulse is not excessively rapid, while others claim it is rare to have this condition exist. The pulse rate ranges from 120 to 130 or more. Hamilton claims after inconsiderable excitement it may reach 170, while the arterial tension is lowered. Tachycardia then is an important objective disturbance. It is asserted that even when the patient is at rest or unexcited the pulse is always a little more rapid than in the normal condition. Again, it is averred by others that it is generally regular, but may be irregular and intermittent. As far as the heart itself is concerned, there may be an oppressive feeling in the chest along with aching pain in the præcordial region, accompanied by a feeling of exhaustion, or a sinking sensation. After such an attack, or one similar in character, the patient may have a profuse perspiration.

Disturbances of Digestion.

In this type of psycho-neuroses dyspepsia appears to be present in a large proportion of the cases. Flatulent dyspepsia with oppression in the epigastrium, along with excessive acidity, is the most common form; constipation is more or less common at all times, and not infrequently do we have neuralgic pains extending from epigastrium to the sides of the chest. In all cases of neurasthenia, gastric irritability is present. At times, neurasthenics of this type are prone to indulge in frequent eating, and owing to the weakness of the digestive apparatus, various gastric and intestinal troubles arise.

THE HYSTERICAL TYPE.

The writer has asserted in the discussion in the first part of this chapter, that when young, healthy, vigorous, and well-balanced persons are exposed to railway and allied accidents, neither vocation nor social status has any influence in the production of traumatic psycho-neurotic trouble. Notwithstanding that these same persons may have been not only exposed to shock and injury, but have received both, still their inherent powers of resistance lead to quick reaction from changed conditions, counter-balancing or rendering nugatory any tendency to ulterior consequences. Again, when traumatic psycho-neuroses, either of the neurasthenic or hysterical type, follow railway injuries, there must be, in order to produce them, existing predisposition, previous and present condition of ill health, mal-effects of bad habits, or some debilitating or exhausting condition incidental to social, financial, or other worries. In brief, the strong, healthy men, the men or persons of resistance or stamina, are never affected with ulterior consequences. There must exist previous debilitating or non-resisting elements at the time of, or prior to, the accident in order that these accidents should produce them. Certain it is that any one having the experience of the railway surgeon does not wonder that traumatic psycho-neurotic troubles do occur, but such a person, considering the intensity of kinetic energy, its consequences, disruption, and the great quantum of force and horrifying circumstances actually existing, wonders that there is not an infinitely greater number of these troubles constantly produced. In the writer's estimation, it is an enigma, God-made and God-endowed, how health, vigor, and stamina, can throw off or react against such intense shock and horrors in the generally rapid manner usual to these accidents.

The writer believes that hysteria is a psychosis, or morbid mental state, or as Janet[1] says: "Hysteria is a mental disease, belonging to the large group of the diseases due to weakness, to cerebral exhaustion."

It will not be pertinent in the scope of this article to discuss whether there are hysterical phenomena which are better explained on a physiological than a psychological basis, nor attempt to refute the contention of the author who attributed all hysterical phenomena to disturbances of the vaso-motor system. Certain it is that Dana's contention[2] that "a large number of these so-called neurasthenias, and all the hysterias, should be classed as prodromal stages, abortive types, or shadowy imitations of the great psychosis, insanity," has a great majority of points in its favor. The continued augmentation of mystifying quiddities, enhanced by discussion and analysis, is not conducive to easy and best comprehension. The assertion made by a prominent layman that degeneration and hysteria are well-defined diseases of which the minor stages are designated as neurasthenia, possesses at least the virtue of comprehension and concentration.

As stated before, both hysteria and neurasthenia may result from railway and allied accidents, particularly where sudden and horrifying circumstances are active and productive of psychic shock with physical injury. Hysteria and neurasthenia can result from slight or severe injury, although it is generally understood that the more severe a physical injury, the less likelihood there is of its being complicated with functional troubles. It is not at all infrequent for both hysterical and neurasthenic states to exist in a greater or less degree after severe physical injury, since in these cases surgical lesions can alone be watched, and any attempt to establish functional conditions is futile. In the diagnosis of traumatic psycho-neuroses, it should be remembered that a combination of both the neurasthenic and the hysterical types may exist, but where we have the existence of hysterical stigmata, we would be justified in taking this as an evidence of the hysterical type of the trouble. In traumatic psycho-neuroses this combination of the hysterical with the neurasthenic is not at all uncommon. Again, as before stated, hysterical symptoms may be present at one period of the attack and not at another. Different periods of examination may disclose different aspects of cases, hence it is reasonable to assume that many discrepancies can arise in the minds of examiners and lead to the confusion which frequently appears in traumatic cases. Knapp[1] says: "In other words, we rarely meet with hysteria of a pure type; it is usually combined with neurasthenic symptoms, hystero-neurasthenia."

---

[1] "The Mental State of Hystericals," by P. Janet, L.H.D., M.D. Putnam's Sons, New York and London, 1901.

[2] "Partial Passing of Neurasthenia," *loc. cit.*

THE MENTAL STATE.

The mental state of the hysterical is one of extreme and excessive emotionalism; this emotionalism, according to Oppenheim, quickly and acutely influencing the motor, vaso-motor, sensory, and secretory functions of the body. They are individuals of self-impelled moods, freaks, and fancies, whose undue and excessive impressionability moulds every action; they readily become extravagantly exalted and in the next moment inordinately depressed, yielding to tears without cause and passing to laughter without reason. An excessive excitability of the imagination conveys to consciousness an endless number of crazy and foolish ideas. The hystericals believe in the truth of all that which the imagination creates, are slaves to suggestion, and believe that all of their ideas or imaginings are based upon true sense perceptions. The hysterical is a many-sided character, lacking in every element of stability, incompetent to indulge in sustained effort, unable or averse to exerting the will; and his too ready accessibility to momentary suggestion makes him extremely changeable and unendowed with constancy. Naturally there are other phases of character in the hysterical besides the one just described. In England and in this country patients may suffer from severe hysteria without evincing excessive emotionalism or undue impressionability. It is presumable that inherited traits of character have more or less influence in the moulding of the hysterical mental state.

SYMPTOMS.

The symptoms of hysteria are divided into two general groups, the permanent, or continued, and the transient, or interparoxysmal. The permanent, or continued, symptoms are called stigmata, and generally last as long as the least indication of the disease exists, hence they are the pathognomonic signs of hysteria. The transient, or inter-paroxysmal, symptoms are called the accidents of hysteria and are superadded to the disease, and do not necessarily belong to it. These are transient, or, at most, periodical and painful to the patient. There is a great diversity of hysterical accidents in different patients. When long in duration, such as paralysis and contractions, they may act or be considered as stigmata. Convulsions, paralysis, and contractures may disappear suddenly.

---

[1] Knapp, *loc. cit.*

SENSORY DISTURBANCES.

Among the most constantly occurring, important, and valuable of the permanent or continued symptoms of hysteria are the sensory disturbances. They constitute a valuable diagnostic element, and as the patients, up to a certain point, are incompetent to tell from what they are suffering, these signs become important objective features of the disease. These sensory disturbances affect the skin, the special senses, and mucous membranes. Anæsthesia is the most common among sensory disturbances of the hysterical type. Its diagnosis demands certain precautions, since there is extreme readiness upon the part of the hysterical patient to react to any suggestion; hence the examination should be so conducted as to avoid suggesting to the patient the real object of the examination. The presence of anæsthesia, for the most part, is unknown to the patient, hence to discriminate and have truthful objective data, the eyes of the patient must be perfectly closed or covered. A distinguishing characteristic of hysterical anæsthesias is that they cause little or no inconvenience to the patient; this is in marked contrast to the disagreeable subjective sensations and inability to perform ordinary actions due to profound anæsthesias arising from organic diseases. Anæsthesia in a moderate form is more constantly found in hysteria than in the intermediate and profound forms. The difference between profound and moderate anæsthesia is a matter of intensity. In the moderate, there is not an absolute loss of sensation to touch, pain, and temperature, while in the profound, there is complete loss, involving joints and the muscular sense. As a rule, there exists hysterical ischæmia of the parts, that is, the pricking of a pin or needle does not cause bleeding. The most common form of cutaneous insensibility is hemianæsthesia, which affects the trunk, limbs, and head, or may be perfectly limited at the middle line of the body. A distinction between hysterical anæsthesia and anæsthesia arising from organic diseases is the perfect alignment of the former to the middle part line of the body.

HEMIANÆSTHESIA.

Whatever may be the degree of anæsthesia, it is not even uniform upon the side affected with the unilateral loss of sensibility; there may be an involvement of the sense organs, loss or defect in hearing, vision, smell, and taste. Scattered areas of anæsthesia may exist on the face, limbs, and body, or be limited to one limb, a hand, or forearm only, or it may be so distributed as to resemble the area covered by a long glove or stocking. Janet[1] asserts that hysterical anæsthesia in all of its forms is characterized by its seeming dependence upon the ideas of the patient more than upon the anatomical construction of the part involved.

HYPERÆSTHESIA.

It is very rare for hyperæsthesias to be general over the body, although at times they may occupy the complete anterior or posterior surface of the trunk. Examinations of patients frequently disclose variability at different times of examination. One day it may be present, the next it may be found either modified or absent. Pains are frequently complained of in different parts of the body; among the most prominent may be mentioned pain in the head, which may be fixed, boring, or penetrating in character. This is known as the *clavus hystericus.*

Small patches of cutaneous sensitiveness, or hyperalgesia, are frequent; their area is about an inch or so, and are generally known to the patient, while the anæsthetic surface is unknown. This tenderness may be superficial, when even the slightest pressure produces pain.

HYSTEROGENIC ZONES.

In some patients there is present, over the various parts of the body, apparently an extreme sensitiveness to the slightest touch, and when pressure is exerted it produces great pain, provoking cries, spasms, and hysterical attacks. Such points, or areas, are called hysterogenic zones. Considering the extent of cutaneous anæsthesia, it could not be expected that any part of the body would be exempt from manifestations. Hence, in hysterical affections, the cutaneous surface is anæsthetic around the joints, the eyelids, conjunctiva, the meatus, and auricle of the ear.

---

[1] Janet Pierre, L.H.D., M.D.: "The Mental State of Hystericals." New York, 1901.

DISTURBANCE OF VISION.

It has already been stated that contraction of the visual field is not present in the neurasthenic type of traumatic psycho-neuroses, but that indistinctness of vision, appearing first in the periphery of the field, consequent upon persistent fixation, superinduces fatigue of the retina. In the hysterical type of traumatic psycho-neuroses, disturbances of vision are frequent. The most diagnostic alteration of vision is a concentric contraction of the field of vision. This contraction is generally present on both sides, but is greater on one side than on the other. The fields of contraction are either regular or irregular in outline, and are generally present where there exists cutaneous anæsthesia. Again, the contraction is greater in degree upon the hemianæsthetic side. When the contraction is slight, it is confined to one eye, and there may be different degrees of contraction. When there is loss of one part of the field of vision, this loss is toward the anæsthetic side, or this ocular defect may occur without anæsthesia and forms a valuable aid when associated with other hysterical symptoms, such as paralysis and contracture.

In a majority of cases central vision is good. In extreme cases acuteness of vision may be affected, though generally unaffected. It happens when the contraction of the field is excessive. Cases of complete blindness are very rare. Loss of vision in one eye is more likely to occur. This blindness in one eye may come on gradually from the contraction of the field, immediately following an hysterical fit, or after traumatism. It is evanescent in duration and clears suddenly. The color field often becomes affected before vision of form. The field for white may be smaller than those for red or blue, or may be reversed, red becoming larger. Among the strange and peculiar phenomena seen in the hysterical type, are cases of monocular diplopia, or polyopia, when the patient may have a repetition of the object four or fivefold, or we occasionally meet with conditions called "macropsia" and "micropsia," that is, in the first instance the object appears too large, in the latter too small. Visual symptoms are in relation to cutaneous anæsthesia. The disorders of taste and smell have the same relation, the loss of taste (ageustia) may involve the entire organ (tongue) and affect all forms of taste. Anosmia (loss of smell) bears the same relation to hemianæsthesia that ageustia does and commonly affects one nostril. Loss of smell may affect both nostrils, but this is very rare. Again, hysterical deafness is generally a part of hemianæsthesia, and bears a relation to anæsthesia. If the anæsthesia is profound, so is the deafness.

Disturbances of Movement—Paralysis.

It has already been stated that the most important motor disturbances in the neurasthenic type of traumatic neuroses is a general loss of power, or muscular enfeeblement. In the hysterical type there is manifest a certain amount of muscular enfeeblement, which is somewhat general, but not having anything like the amplitude existing in paralysis. This muscular enfeeblement is vague and indefinite and may influence muscular action generally. Muscular enfeeblement is complained of by patients in all degrees, from the slightest loss of use to complete paralysis. Hysterical paralysis may result from traumatism, or may be the result of violent emotion, or follow an " hysterical fit." Paralysis resulting from trauma or injury sometimes comes on immediately, but more frequently after an interval of hours or days, but there is a more or less indefinite period of incubation. The injury may be very slight, and yet result in serious and persistent paralysis.

Among the peculiarities of hysterical paralysis is the absence of muscular wasting. Naturally when paralysis has existed for a long time there is some wasting, and this wasting is logically attributed to muscular disuse. Hysterical paralysis may suddenly disappear for any trivial or insufficient cause. In hysterical paralysis there is never reaction of degeneration. The reactions are unchanged; there is some diminution in response to both currents. In some cases the reflexes are exaggerated, but never to the same extent as when organic lesion is present. The deep reflexes are never lost. Hysterical paralysis consists of three forms: First, hemiplegia; second, paraplegia; third, monoplegia, and a very rare form involving both extremities simultaneously. Hysterical hemiplegia, like hysterical paraplegia and monoplegia, may appear immediately, or there may be an interval of hours or days, following psychic shock and injury. In very exceptional instances the face and tongue are involved. Hemiplegia, like hysterical monoplegia, occurs more frequently upon the left side than upon the right. With hemiplegia hemianæsthesia is generally present. There may be also hyperalgesic patches; when an arm and a leg is affected, one or both may be flaccid or rigid. The superficial reflexes are often absent, the knee-jerk sometimes exaggerated, and a typical ankle clonus can sometimes be obtained. If the patient is capable of locomotion the leg is dragged rigidly behind, and not circumducted, as when an organic lesion is present.

Paraplegia.

The most common forms of hysterical paralysis, according to Bailey,[1] are hemiplegia, brachial monoplegia, and paraplegia. Two forms of paraplegic paralysis exist, the flaccid and rigid; in the flaccid form the muscles are uncontracted and flaccid; in the second, the muscles are contracted and rigid. In the rigid form rigidity is present in all positions of the limb. Now and then persistent contracture of the great toes in extension is present. In the most typical form of this trouble affections of sensation are manifest, but they do not occur in all cases. Anæsthesia exists in varying degree over both lower extremities, ending regularly at the groin in front, behind on a level with the gluteal folds. Pain over the lower part of the spine, or sacrum, is more or less constant in paraplegia. In the beginning there may be retention of urine. Incontinence very rarely occurs. Muscular twitchings are sometimes troublesome. When movement is indulged in, patients frequently complain of pain in the joints. Decubitus is absent, although the legs and feet may be somewhat œdematous and cold, and present a bluish and congested appearance.

Monoplegia.

Paralysis may involve one limb. Bailey claims that monoplegia of the arm is the most frequent form in hysterical paralysis due to traumatism. Clarke[2] says, "paralysis of one limb or a part of it, that is to say, the forearm and hand, or the leg below

---

[1] *Loc. cit.*

[2] *Loc. cit.*

the knee, is occasionally met with, more frequently as the result of an injury, slight or severe, or sometimes as the result of the treatment of an injury by immobilization in a splint." Anæsthesia of an affected limb is segmentary and corresponds more or less closely to the area of paralysis.

CONTRACTURES.

The causes of paralysis also produce contractures, and, additionally, injury is very commonly imputed as a cause. Like paralysis, contractures may come on gradually or suddenly.

Féré says,[1] "one can change the normal into an hysterical individual by tiring him. All these causes which produce hysteria can, as far as the pathogenic part they play is concerned, be traced to one simple physiological process, namely, fatigue and depression of vitality." Employees who have been idle for some time frequently come to the hospital three or four days after resuming work, presenting evidences of some hysterical symptom, as, for example, decided contracture of the muscle of the hand and forearm from excessive use of the upper extremity. This generally comes on suddenly by some blow on the forearm, or other slight injury, and owing to the spastic condition of the muscles of the forearm the patient is unable to work. In many of these cases more or less general tremors of the body occur, some have persistently lasted for a week or more, but they rarely last beyond seventy-two hours, and less. The contracture may affect all the extensor muscles of the great toe, and this is now and then associated with paraplegia, or the limb may stand up so as to cause the muscles of the thigh to be persistently flexed on the pelvis. Single and multiple contraction may exist, involving muscles in many parts of the body.

HYSTERICAL JOINT AFFECTIONS.

Trivial traumatism plays a potent part in hysterical affections, particularly so in hysterical joint troubles, and sometimes this is the only sign of hysteria. According to Charcot, the joint most frequently involved is the knee-joint. Pain is the essential symptom, and starts superficially; hyperæsthesia is now and then present over the joint. The hip-joint is next in frequency of occurrence, symptoms of spasmodic contraction or

[1] Féré, Ch.: La Semaine médicale, Paris, 1890, p. 192.

rigidity of the muscles around the joint are first noticed, and spread at times to all the muscles of the limb.

Where the hip-joint is involved, the abductor and flexor muscles are influenced in the early stages of the trouble. There is no actual swelling or shortening of the limb, or change of bone surface. The joints of the whole limb may become cold and blue in proportion to the long standing of the joint trouble; there is more or less muscular wasting. The disappearance of these joint troubles, like their appearance, may be spontaneous. Their diagnosis depends on the presence of other symptoms of hysteria and the lack of organic evidences.

DISTURBANCES OF RESPIRATION AND SPEECH.

Among the disturbances of respiration, dyspnœa, tachypnœa, and cough, are of more or less constant occurrence in the hysterical type of traumatic psycho-neuroses. The dyspnœa in some cases is due to the spasm of the glottis. Hysterical dyspnœa may be paroxysmal or continuous in character. In the continuous form stertor may be present during inspiration and only slight during expiration. An increased rapidity of respiration constitutes the chief element in tachypnœa; from 60 to 80, or even 160 inspirations per minute may be counted, which may be maintained for some time. This, like many other hysterical accidents, begins and ends suddenly. The pulse is not accelerated; there is but little distress and no evidence of illness. Temperature is normal. Now and then there are diaphragmatic spasms which cease when sleep occurs. Hysterical coughs are always noisy, loud, or monotonously hacking. Spasmodic coughs, almost as loud, occur in children. No expectoration is present. Clarke[1] says: "Often cough consists of a long inspiration followed by a series of short, noisy expirations." Others produce noises in the larynx, resembling the cries of various animals. A barking sound is frequent. Epidemics of these noises may occur, as in the instance cited by Gilles de la Tourette, in which nuns in a convent took to mewing like cats, disturbing the neighborhood. Attacks of long continued and violent yawning, sneezing, and hiccough occur in the paroxysmal form. Charcot mentions a patient who yawned 7,200 times in fifteen minutes.

Hysterical aphonia is not common in traumatic psycho-neuroses. The writer has never seen a case of this character. Anæsthesia of the fauces with a loss of the pharyngeal reflex is somewhat common. Hysterical mutism is a rare affection at best, and rarer still in traumatic cases. A typical case of mutism shows the patient utterly unable to produce a sound.

---

[1] *Loc. cit.*

Hysterical stammering now and then occurs.

Character of Attacks, and General Remarks.

Briquet[1] asserts that "hysteria is a general disease which modifies the whole organism," but it is evident that racial elements are constantly acting factors in modifying the intensity of its manifestations. The milder forms of hysteria are more constantly found in England and in America than in Continental countries. Hysteria is found in a more severe form in France than in Germany. No race appears to be exempt from it.

The classical hysterical fits—*grande hystérie*,[2] according to all American auhorities, is very rare in this country. The part which trauma plays (arising from railway injuries) in the production of hysteria, in the writer's experience, represents a very varied picture, not at all uniform in its manifestations nor constant in its symptomatology. In all probability this irregularity of hysterical manifestations and varied symptomatology arise from the frequent combination of hysteria with neurasthenia. In traumatic hysteria arising from railway injuries many elements of a complete fit are frequently absent, the attack generally showing itself by the "*globus*" or "*clavus*," followed by an emotional attack, wherein tears are shed, and rarely uncontrollable laughter. The writer has never seen in man the episodes of a full attack of hysteria arising from railway injuries. He has seen the patient lying motionless in bed with some rigidity of the limbs, the eyelids, if closed, showing movements of the ball under them, with more or less rapid flicking of the eyelids; now and then the patient moaned or sighed, and sometimes lost consciousness partially, but could be aroused; convulsions mild in character, delirium absent, no wild fits of raving or tearing of hair or clothing. In brief, the hysterical fit arising from railway injuries, in the writer's experience, is more frequently of the mono-symptomatic type than that of the complete attack.

---

[1] Briquet: "Traité d'Hystérie," 1859, p. 517.

[2] Clarke gives the following as the episodes of the full attack of hystero-epilepsy (grande hystérie):

1. Premonitory symptoms—auras.
2. Stages of the attack proper: (*a*) Epileptic period. (1) Phase of tonic contraction. (2) Phase of clonic contraction. (3) Phase of resolution. (*b*) Period of contractions and of clownism. (1) Phase of illogical attitudes. (2) Phase of grande movements. (*c*) Period of passionate, emotional attitudes. (*d*) Period of delirium.
3. Terminal phenomena, contractions, paralysis, etc.

THE GRAVE TRAUMATIC PSYCHO-NEUROSIS.

Recent classification includes under the head of "Traumatic Psycho-neuroses" three forms of trouble due to traumatism: First, traumatic neurasthenia; second, traumatic hysteria; third, grave traumatic psycho-neurosis. In Hamilton's well-expressed words: "An alleged condition, the outgrowth of one or both, and practically an incurable trouble." These cases are generally the result of severe traumatisms, and may partake of the nature of neurasthenia, or hysterical trouble, and additionally the nature of organic disease. Superadded to traumatic neurasthenia are hysterical symptoms partaking of the nature of that condition known as disseminated sclerosis of the cord and brain, which are believed to be actual organic lesions. Their exact nature has not been definitely determined and they are extremely rare in this country. Dana[1] says: "There is a steady and even gradation between cases of severe traumatic neurasthenia, traumatic hysteria, and the grave traumatic neurosis sclerosis. Just as it is exceedingly difficult to draw a sharp line between the very exaggerated type of traumatic hysteria and a case which seems to be a disseminated sclerosis. . . . The causes of the development of this form of trouble are traumatisms which are particularly severe, and in which the head has been injured." This condition must indeed be rare; the writer has never seen a case of this description occurring from railway injuries.

THE DIFFERENCE BETWEEN AN HYSTERICAL AND AN EPILEPTIC FIT.

At times it becomes imperative to differentiate between hysterical and epileptic fits. Hysteria is often caused by excited feelings; epilepsy has no definite cause. The aura is present and more or less prolonged in hysteria; in epilepsy, if there be an aura, it is of transient duration. Onset is gradual in hysteria and sudden in epilepsy. In hysteria the subjects are never hurt by falling, while in epilepsy they are frequently hurt. The tongue is never bitten in hysteria; frequently bitten in epilepsy. Sphincters of rectum and bladder are unaffected in hysteria; hence, urine and fæces never pass involuntarily. But in epilepsy the urine is frequently passed, and at times the fæces. Loud cries or screams may occur in the course of hysterical fits; only one cry in epilepsy. In hysteria, loss of consciousness is not complete; in epilepsy, unconsciousness is profound. In hysteria, the patient remembers the fit, at least in part; while in epilepsy there is no remembrance of the attack. In the hysterical fit, delirium is frequently present with rapid recovery to the normal condition. In epilepsy, there is never any delirium after the fit, patient becoming stupid, dull, and dazed.

---

[1] *Loc. cit.*

Subsequent Progress Seemingly Dependent upon Favorable Surroundings and Conditions.

The inability to follow the subsequent history constitutes a seemingly impassable barrier as to correct ultimate prognosis, although the writer's opportunities are superior in many instances to those of the general run of practitioners, since railway employees working upon a railway having hospital departments remain under the observation of the hospital medical attendants for months and years. The writer is firm in his conviction that when the employee has settled his claim and returns to work, generally to some light form of labor, he is placed in the best possible position to regain health and usefulness. He does not face hardships. His medical treatment and medicine cost him nothing; he can obtain treatment at any time, either as an "in"-patient or as an "out"-patient. He has received compensation, he now gets his wage regularly, and his mental worries are at a minimum. Contrast this condition with many of the poor, needy, and mentally harassed persons which the neurologists see, poorly nourished persons who cannot depend with any certainty upon the outcome of their financial state a day in advance, without attention, and amid conditions of squalor and worry. Hence there need be no wonder that the neurologist sees so many incurable cases, both of the hysterical and neurasthenic types, among the poor. The writer believes that the future improvement, or the establishment of an incurable condition, depends in a great majority of cases upon their immediate unsatisfied wants, miserable surroundings, and uncertainties of life.

Again, the employee's surroundings are free from suggestive element. His hope keeps its natural bent, for he knows that as soon as he is in condition to resume his former vocation, he will have no trouble to regain his position. So that mentally he has everything to encourage him; no prospect of helplessness faces him; for these reasons these persons rarely run into confirmed and incurable states of hysteria and neurasthenia.

Regarding the passenger, this is different. The railway surgeon rarely sees these cases, except in consultation, and must obtain his opinions of the case largely from related history, or such evidences as are manifest at the time of examination. Hence, at best, he can obtain only an incomplete view of the case, and is not competent to state what the future has in store.

The influence of settlement of claim upon the future progress of the case, in the writer's experience, indicates that when traumatic psycho-neurosis, either of an hysterical or neurasthenic type, exists, other elements have even more potency regarding future prognosis than compensation. We do not doubt that compensation has its influence in a certain number of cases, but we do know that where subsequent surrounding conditions are sufficiently intense, compensation cannot become a curative agent. In one instance, within the writer's knowledge, a case of traumatic hysteria received favorable settlement, but owing to the intervention of bad habits, the hysteria increased in intensity many months after compensation, and the patient died fourteen months after the injury. How much intemperate habits were to blame, and how much hysteria, we are unable to state.

SOME OTHER CAUSES IN THE PRODUCTION OF FUNCTIONAL TROUBLES BESIDES TRAUMA.

It will be seen that we have attempted to draw a line between cases which are plainly the resultant of physical causes and others having psychical causes. We do not believe that there is any sharply defined type of disease which can be properly called traumatic; but we do sincerely believe that there are many cases which are dependent entirely upon the force and condition which are created; and, in addition thereto, that the purely psychic conditions produced by traumatism are separate and distinct from those depending entirely upon physical condition. While realizing that, owing to the by-play of extraordinary circumstances, trivial injuries, particularly with the back symptoms, can readily shade themselves into psycho-neuroses, yet we naturally believe that racial differences, perfection of physical condition, and the multiplex force of surroundings are constantly modifying factors. We believe that favorable surroundings and the influence of an unprejudiced and thoroughly impartial medical attendant will be productive of the exact condition of trauma as it exists. And if trauma produces a condition similar to hypnosis, as in traumatic hysteria, we cannot help believing that the existing force and predetermined mental condition of the medical attendant will oftentimes change trivial conditions into serious ones. It seems rather startling that the physician, by virtue of mental superiority, prejudice, and suggestion could create an essentially serious condition; but we candidly believe that it is possible in a weakened and receptive mind to suggest and develop consequences of a very serious nature. And if, as claimed by authority, such cases have been cured by hypnosis, it certainly seems natural that hypnotic suggestion would have equal effect in their causation when the conditions are favorable to it. There cannot be any doubt, if I may so use the word, that traumatized minds absorb sensations not only directly from the effects of the injury, but also receive impressions produced by the suggestions of an already convinced mind; as exemplified in the description of cases given. We cannot believe that there is a typical complex of symptoms in every case possessing anything like uniformity; but the local trauma aids to develop the psycho-neurosis dependent upon predisposing central disturbances and peculiarities. But where we have physical perfection and mental strength, trauma is very rarely likely to produce the psychic condition peculiar to a so-called traumatic neurosis. For we find that where intelligence is blunted, where surroundings have made incidental elements of danger familiar, physical injuries are manifested as physical injuries, and very rarely terminate in psychic troubles unless there exist extremes in intensity and a predisposition upon the part of the individual, be it racial, inherited, or acquired.

CHAPTER IV.

AN ANALYSIS OF THE MEDICO-LEGAL DIAGNOSTIC ELEMENTS ENTERING INTO TRAUMATIC NEUROSES AND OTHER CONDITIONS ARISING FROM RAILWAY ACCIDENTS.

1st. A consideration of litigation and some inconsistencies.—2d. The reason why the expert is employed.—3d. Frequency of simulation.—4th. Defects of vision as diagnostic signs.—5th. The importance of complete history of cases.—6th. General elements of the examination.—7th. The dangers of long-continued and multiple examinations.—8th. A study of objective symptoms—Face.—9th. Gait and attitude.—10th. Locomotion and test for co-ordination.—11th. Disturbances of special senses—Diagnosis.—12th. Disturbances of the circulatory system.—13th. Fibrillary tremblings of muscles of face and influence on speech.—14th. Digestive disturbances.—15th. Tests for sensibility—Their vagaries.—16th. The Mannskopf sign.—17th. Influence of compensation upon the clinical features of railway injuries.—18th. Malingering—A general consideration.—19th. Special characteristics of malingering and exaggeration.—20th. So-called detective means to determine malingering.—21st. A consideration of precedent diseases, or so-called substitution of origin.

A CONSIDERATION OF LITIGATION AND SOME INCONSISTENCIES.

It is an almost invariable rule that where personal injuries have been inflicted by the railway, claims for damages are made. However, it is not an infrequent occurrence to have the good sense of both corporation and injured individual manifested in just compromise. This should always be commended, as aggravating circumstance is almost completely eliminated, and what might ultimately be harrowing and pathologizing conditions to the person injured rendered null and void. Elements attendant upon litigation, particularly where we have marked psychic trouble, as presented in traumatic neurosis, possess positive causative influence, and seem almost invariably to pertain to the abnormal. Thus, continued mental tension, the violent play of passions—at times exaltation, then deferred hopes, stinging delay; vexatious suggestion, harassing expense —engender a wretched and unfortunate psychic condition. The unimpeded and full force of immediate surroundings, wherein every element is seemingly made to act in its most effective manner, favor a condition of unrest and debilitating circumstance, continued from beginning to end. The excitement, strain, and harassing elements, which are generally attendant upon litigation, even in ordinary matters, seem to be competent at times to create neurotics out of men in normal condition. What, then, must it do to an already diseased individual? All experience indicates that cases of traumatic neurosis invariably grow worse while any legal suits are pending; that impassioned circumstances and termless tension stamp themselves profoundly upon the already weak mental condition. Hence the conscientious medical attendant uses, as an element of treatment, anything to quiet the psychic condition. He will explain the full meaning of compromise, indicating honestly to the patient that the unrest incident to litigation robs his remedial measures of efficiency. He will suggest that an early settlement is one of the means of cure; that is, if cure is possible, all elements of excitation are to be eliminated in the treatment of his case.

In an experience of many years we find that many railway corporations recognize the honest opinion of scientific men, and use compromise as an economic and intelligent factor in dealing particularly with cases of traumatic neurosis; being equally as anxious as the patient to avoid a long, tedious, and expensive suit.

Many cases of traumatic psycho-neurosis are emphasized, nourished, and developed by surroundings and circumstances which are oftentimes more potent in their effects than the initial injury. Thus, E. C. Seguin[1] says: "Supposing the case of a predisposed person, frightened and jarred by severe accident, who subsequently receives harmful sympathy from relatives and physicians, who is made the object of multitudinous suggestions by physicians, lawyers, and friends; whose volition and reactive powers are impaired by nervines and sedatives; then, even without a trace of voluntary or intentional malingering, a neurotic state is developed which gets beyond—utterly beyond—the control of the patient and the influence of the treatment. Such a patient has lost hold of his nervous system, after the fashion of the morphinist, and cannot regain control." In many cases of so-called traumatic psycho-neurosis, the only advocation at times is an injury upon a railway train as passenger. It is immaterial what the attendant conditions were; whether gravity and force played their part even in their feeblest forms. A passenger, slight collision or derailment, and then the assertion "that it will not do to conclude that the blow should be severe to produce a permanent injury," are sufficient. In unison with this thought, any one who will examine court records of the past will discover continuous injustice in the findings for or against railway corporations. A spirit of unfairness has been evolved, where justice is lost sight of, and medical experts, both for plaintiff and defendant, losing the true and real intent of experts, have become factious partisans, thereby producing on court, attorneys, jury, and laity a conviction of the thorough unreliability of medical expert testimony, suggesting at times even its dishonesty. So deeply ingrown has the prejudice against railway corporations become, that we have heard an intelligent and zealous attorney say that if he could but indicate that his client had the sensation of "pins and needles," suggesting the bare possibility of paralysis, he could descant darkly on the future, and nullify scientific testimony. No more complete farces have ever been enacted upon the stage than in the forum of justice. Such failures are largely due to ignorance in the selection of experts, who are generally chosen by the attorneys themselves; and, again, cupidity eternally faces honest assertions, and possible ulterior results are made a pretext to accomplish absolute dishonesty. The anomalous positions in which experts are placed discredit them. With unprincipled motives, experts are called into court, after no more than a single examination of the alleged sufferer has been made. The medical expert for the railway, or defendant, is not infrequently refused the courtesy of an examination. Decided opinions are given with unconcern by the plaintiff's expert, after no more than a single examination. In consequence, ignorance and injustice cloak themselves in the garb of science.

---

[1] Annual of the Universal Med. Sciences, 1889. F. A. Davis, Pub., N. Y.

No honest physician desires either to harm or to do injustice to a railway corporation, and certainly no one could wish to injure an honest and gravely injured individual. Still less would a physician seek to be a party to fraud by assisting a dishonest claimant in obtaining damages.

Physicians well versed in the literature of traumatic psycho-neuroses cannot possibly believe that a single examination of a case will enable them to determine and verify symptoms. It is an established fact that the differential diagnosis of traumatic psycho-neurosis has not its parallel in all medicine, and that oftentimes at least a year or more may be required for observation before a just prognosis can be given. Where the usefulness and mental and physical integrity of an individual are involved in an opinion, honesty and justice demand that it be based upon efficient and conscientious study. We believe that scientific investigation will soon demonstrate that regularity and consistency are not to be subverted even by traumatic psycho-neuroses. The law demands, in questions of doubt, that only usual, natural, and proximate effects shall be considered; that which is remotely speculative must be ignored. The law likewise requires that in all cases of personal injuries, the recovery of damages shall be exactly commensurate with the injury sustained.

What expert can truthfully state even approximately the full measure of damages when imperfect methods of examining injured individuals are pursued? There could be no honorable demand for damages for complications foreign to an original injury; for complications engendered by diverse conditions, having no direct relations to the injury for which recompense is sought. In all other conditions following injury, the true relations are considered, but in traumatic psycho-neuroses, aiding and developing factors are placed to the credit of the primary cause. In these cases no account is taken of the influence of suggestions or omissions on the part of the physicians or attendants, even though they may have created neurotic conditions, and the railway company is made to bear the full weight of causation. But with reference to such factors, unless a sharply defined line is made apparent, we then enter the realm of speculation, where the law will not follow us. Moreover, an injured person is required to use only a reasonable degree of care to prevent or avert serious consequences; and therefore, if such a one has exercised reasonable caution and prudence in the selection of a physician's attendance and surroundings, he has fully met the requirements of the law. But there is no proper definition of what reasonable caution and prudence are in the selection of a physician. The law, in its endeavor to be broad and liberal, becomes inefficient and unjust. How incongruous and inefficient are its workings in this direction!

Certain it is that only the competent neurologist, or at least one versed in observation of this peculiar condition, is competent to correctly diagnosticate and treat it—a disease susceptible to the influence of every adverse condition, fed by suggestions, and nourished and intensified by unfavorable circumstances. The statutes of various States demand only a legalized physician; and in such States the sole requirement to legalize a physician is so-called practice of medicine. Medical knowledge and education are not the criteria, but length of time spent as a practising physician. Though a man may be a "quack" of the worst order, he may still be a legalized practitioner of medicine. Again, in more than one State of our country we find boards of medical examiners, whose duty it is to pass upon the qualifications of would-be physicians; but frequently these boards are composed of the most inferior and incompetent members of the medical profession; men whose education often has not gone beyond reading and writing, with no thoroughness even there. If men devoid of education are thus made legal practitioners of medicine, the fault lies with the public.

THE REASON WHY THE EXPERT IS EMPLOYED.

Compensation is certainly invariably an important factor in these cases. Upon an expert who gives testimony in them is imposed the necessity of being competent in this line of work. For, in ascertaining and estimating the amount of compensation to be awarded in actions for personal injuries, it is necessary to consider mental anguish, physical pain, and the extent and permanency of loss of earning-power. It is important that the physician and the attorney should have a degree of knowledge and information concerning the relationship which mental and nervous forces bear to the physical facts in any given case that will enable them to present tangible evidence, definite proof, of the extent and consequences of injuries. Since the damages awarded for physical and mental pain, etc., are compensatory and not punitive, it becomes very important to be able to prove, with some degree of exactness, the amount of physical suffering and permanency of the effects produced by a given injury. Mental pain is inferable from demonstrable physical pain. Again, mental pain may be engendered incidentally by the intensity of surrounding force and circumstances. Aside from these relations, a true interpretation of purely subjective phenomena can only be made by the experienced expert. The layman has no guide in the determination of the degree of pain, be it mental or physical, unless he has experienced personally similar injury and pain. But the physician, aided by his own and the experience of others, can approximately estimate from physical facts the degree of intensity of pain consequent upon injury, as well as its extent and permanency. Such features always require the employment of expert testimony. Without it, a jury would be left to draw conclusions from the imperfect data of limited experience and observation.

There rests upon the honest and conscientious physician a real and great responsibility in the examination of these cases; and any physician who begins prejudiced surely starts wrong. His examination should be made in the light of existing science, and the more closely he adheres to the true intent and purpose of science, the more surely will he accomplish the real and intended purpose of the examination. Warped and prejudiced opinions in the beginning of an examination naturally entail warped and prejudiced conclusions. There should always be that just appreciation of that high moral obligation which the true nature of his vocation imposes upon him; there cannot possibly be any value attached to views influenced by prejudice. The first endeavor should be to determine what connection there is in the person under examination between the present illness and the accident of which he is supposed to be suffering the consequence. Of what degree is the incapacity? Is he only partially or completely disabled? How long is this disability likely to continue? Is there exaggeration, and what is its extent? What is the degree and extent of simulation? Or is it a case of gross malingering?

At the outset of an examination it is to be remembered that the symptoms may partake of the characters of both traumatic hysteria and neurasthenia; that such symptoms are more or less commonly associated with back injuries, sprains, contusions, concussions where we have muscular and ligamentous sprains or ruptures and injury to spinal nerve, and, as expressed by Dana,[1] "mental shocks and physical bruises."

THE FREQUENCY OF SIMULATION.

It is certainly confusing to note the relative differences in the views expressed by various authors concerning the frequency of simulation; and that, too, under the varying changes which a single year brings forth. In this country it is rare indeed to have patients placed under proper conditions for thorough scientific watching. For many years past we have heard experts deliver decided opinions after only a single examination of a patient; as for repeated examinations, they are very rarely made except by the thoroughly conscientious and competent neurologist or one particularly versed in this trouble. We believe that it can be honestly maintained that no one can even approximately determine the extent and absolute condition of such patients by means of one examination; that under some circumstances, months are required to honestly pronounce upon a case of traumatic psycho-neurosis, especially regarding prognosis. How is it possible, where such loose methods are employed, to avoid strengthening the impression, already made upon the legal profession and the courts of law, of the thorough unreliability of expert testimony? Where the interpretation of truth is based upon such imperfection, certain it is that if the surroundings as exemplified by lawyer and court were not as eagerly indifferent and prejudiced, such falseness would not be tolerated. As Colton says: "The interests of society often render it expedient not to utter the whole truth, the interest of science never; for in this field we have much more to fear from deficiency of truth than from its abundance." E. C. Seguin[2] says: "It has seemed to me that the question is not fully considered by writers upon the subject regarding the elements of malingering; they all refer more or less to deliberate malingering, which we admit is rare. But in private practice, in cases of non-traumatic neurosis, we are constantly confronted with elements of exaggeration and positively false statements made by patients who have no immediate or pecuniary object in view. Under the most unex-

[1] *Loc. cit.*

[2] *Loc. cit.*

pected circumstances, we discover, usually long after the first examination of the case, that certain symptoms are either purposely produced or grossly exaggerated. In railway cases, where we have examined this element of possible non-deliberate malingering, it has been very prominent. For example, in a case recently seen, the patient could lift and turn her heavy body by the help of her hands, yet her grasp on the dynamometer gave the ridiculous figures of 5.3 degrees, or, in other words, no grasp at all."

Again, Spitzka says: "The most difficult element in these cases is the distinction of the genuine disorder from simulation. As far as I can judge from the testimony given in a number of them as to the existence of real or feigned disease, I should be inclined to believe that over one-half of those in which the verdict has been secured, including several in which very large sums have been paid, were and are shams."

In a discussion before the British Medical Association[1] elicited by the reading of a paper by Dr. Byrom Bramwell on "Concussion of the Spine, with Especial Reference to Railway Accidents and Injuries," the following were the reported utterances regarding the frequency of simulation:

Dr. Buzzard of England averred that there was so much simulation in railway cases that he had positively declined seeing them. Dr. Clifford Allbutt of the same country asserted that ninety-nine in one hundred cases of so-called traumatic neuroses arising from railway accidents were simulated and nonsensical. Dr. Brookhouse asserted that simulation of symptoms of concussion were constant and simple. In fact, the concurrent opinion of English surgeons seems to be constantly at variance with those of continental authors. The extremes are to be found in a comparison of English, French, and German writers. Bouveret and Dubois of France believe that simulation is extremely rare. Owing to the wonderful influence of Oppenheim, German physicians present much contrariety of opinion regarding simulation. Oppenheim finds only four cases of simulation in one hundred. Hoffman observed in twenty-four cases eight simulants; he and Schultze claim that thirty-three per cent. of all other cases were simulated. Schultze now, on reconsideration, claims that his former high per cent.

[1] New York Medical Record, August, 1893.

was excessive, and places the simulations at ten per cent. Rumpf of Marbourg places the percentage at ten per cent.; Seeligmüller of Halle still places his estimate of simulation at twenty-five per cent. In our own country, our best authors have not been at any time very expressive as regards the percentage of simulation, but many writers have been very free in expressing their opinion regarding prognosis. Putnam, Knapp, and Dercum claim that simulation is of rare occurrence. Walton is inclined to the belief that simulation is somewhat frequent. It is hardly necessary to quote at length the various beliefs in this direction; suffice it to say that extremes are constant, some physicians of experience averring that simulation runs as high as seventy-five per cent. It has been asserted by strong authority that there are objective evidences present in every case, which, while they may evince more or less elements of uniformity, have not yet been properly formulated; and the true method of absolute determination of simulation has yet to be proposed. It is said that by varying the examination one may exclude simulation and constantly verify results.

We have purposely given these wide differences in percentage because there must undoubtedly be some very strong reason why they should exist; and it suggests upon the face of these varied assertions that racial differences probably have influence. No one can dispute the honesty of the author quoted, nor can his fine ability be questioned. It can be asserted with truth that investigators in France, Germany, England, and this country describe these cases just as they are seen.[1] Hence, if the assertions attributed to the various writers are true, there must be a radical difference between cases reported in England and those reported in France and Germany. It is not an illogical reason to assign, that probably there is something in that unknown factor of racial element which is competent to produce varying effects; this may be particularly emphasized in traumatic hysteria, to what extent has never yet been determined. While this might partially explain, still it has been asserted that mechanical contrivances used upon the railway at the present time—the Westinghouse brake, the vestibule—have, in many instances, changed the conditions which accompany these accidents, and that traumatic neurosis as described at the present day does not present some of the essential conditions which were engendered when Erichsen first described this condition. While this may be so in a goodly number of instances, while the very elements of force have been materially lessened by these appliances, yet it cannot be a constantly acting, modifying cause, particularly in those cases where circumstances engender fright-neuroses, with or without any evidence of physical injury—where we have the so-called "egg-shell" organization, as expressed by Clevenger, which merely indicates a constant predisposing cause, be it in the shape of a predisposing neurosis or where there are other evidences of constitutional deficiency. We do not desire to detract from the full force of predisposition, which we realize is potent, but we do sincerely desire to draw a common-sense line of demarcation between inadequate physical causes and physical integrity. We do not believe that the combined experience of all investigators will show that a physically perfect individual reacts in an extraordinary way to ordinary injury. Exaggeration of symptoms seems to be prominent not only in hysterical and neurasthenic trauma, but also even in ordinary injuries; there seems to be a tendency to make injuries occurring upon railways much worse than those occurring under other circumstances.

---

[1] Thus, Clevenger says: "S. Weir Mitchell during the late war made extensive researches with regard to direct injuries to nerves, and the traumatic neuroses described in his book differ widely from those investigated by Oppenheim." So acute an observer as Mitchell certainly described just what he saw.

While this may have its origin, in many cases, in the hope of future compensation, yet oftentimes the very element of exaggeration is indicative of the effects of psychic trauma. Page expresses this very well when he says: "If, as it has been said, the motive is so strong and so prevailing, it is natural and only human that exaggeration should be met with in a large proportion of the cases injured in railway accidents. But, on the other hand, it must be remembered that exaggeration may not be, nay, very often is not, altogether wilful or assumed. Exaggeration is the very essence of many of those emotional or hysterical disorders which are so common in both sexes after the shock of collisions. Here it may be an idiosyncrasy of the individual; there it may be the outcome of mental disturbance from the fright and alarm amid which the injury is received. It is only by a consideration of every feature and aspect of the case—clinical, pathological, social, and moral—that you can rightly estimate the kind of exaggeration or malingering with which you have to do."

DEFECTS OF VISION AS A DIAGNOSTIC SIGN.

In traumatic psycho-neuroses arising from railway injuries, the concurrence of opinion plainly points to the fact that while functional eye symptoms arising therefrom are very generally present, it is extremely rare to have them followed by any organic change. These functional troubles undoubtedly constantly partake of the nature of hysteria and neurasthenia, and they are emphasized in proportion as the well-marked elements of both of these conditions are present. English authors stubbornly deny that there are any definite changes which can be considered as occurring regularly in the eyes after railway injury.

Thus, Dr. Byrom Bramwell said that changes in the fundus oculi are said to occur after railway accidents. The optic disc was said sometimes to be altered in appearance. In his experience this did not occur. Dr. Clifford Allbutt regarded atrophic condition of the optic nerve as possible, but this symptom must not be made too much of, in consequence of its infrequency. Dr. Buzzards states that he has never seen optic atrophy after railway injury.[1] It is hardly necessary to quote further, except to mention the fact that both Thorburn and Page are in unison with the views above mentioned.

Among functional eye symptoms, special modification of the field of color vision is usual, but it is not always present. It is considered that the size of the pupil affords a reliable evidence as regards the nervous condition of a patient suffering with traumatic neurosis. The condition of the pupil varies, transient differences in its size existing at times, necessitating more than one examination. Dilatation of the pupil indicates, according to Page and others, a lack of nerve-tone, while the converse, a small pupil, is a rare accompaniment. As averred by Page, this symptom is simulated now and then by the introduction of atropin in the eye. Photophobia is not considered a constant symptom, but for the most part occurs where we have well-pronounced psychic shock, but, as a rule, it is transient, existing only during the time of the full manifestation of shock.

---

[1] New York Medical Record, *loc. cit.*

It has been asserted by competent observers that light of only medium intensity should be used in examination of the eye. Guillemand[1] says: "As to the enfeeblement of the visual acuteness, diplopia, and strabismus, although they can be vigorously imitated by a patient well versed in the disease, still they are useful to us, for it is rare that they are known to the individual submitted for our examination." Narrowing of the visual field is one of the signs which have served most often to disprove the simulation of which a patient has been accused. Probably no symptom in the entire discussion regarding traumatic psycho-neurosis has received more attention than contraction of the visual field, predicated upon the fact that it is considered to be the most valued and constant symptom to prove this condition. Oppenheim says: "I have particularly noticed this sign, and never neglect in important researches to make careful perimetric examination, and even to repeat it several times. I have arrived at the conclusion that concentric contraction of the visual field is found in a great number of cases. When I found it in a minor degree, although it was certainly pathological, I allowed it significance only if it was constantly shown, and if it was found on the same side of the body which was injured. As a proof of simulation, it is said that in certain cases the visual field during the examination at different distances does not show the variations which ought to be expected as corresponding to the opening of the angle. But this assertion rests on a wrong idea. Restriction of the visual field in functional neuroses, just like their symptoms, are governed by laws different from those imposed in diseases of the brain having an organic origin. Thus, for example, a person who has only seen ordinary hemiplegias will, as a result, think everything simulation if for the first time he examines a hysterical hemiplegia."

It will not be inapropos at this juncture to cite the case of a patient who was supposed to be suffering from traumatic psycho-neurosis. This case was sent to the oculist without any previous explanation, and his report follows:

> "I did not ask a single question about his symptoms before proceeding to measure his visual fields. The left visual field, except for a slight contraction—the nose notch does, of course, not count—is virtually normal, and denotes absolutely nothing. This was the eye I examined as the second one, and I was almost convinced that he thought he was

---

[1] *Loc. cit.*

gaining something by stretching his field a little. The field of his right eye, which I examined first, shows quite a number of contractions, irregular in shape, still in general concentric. This is the eye which has also a little less visual acuity than its fellow. In both the visual acuity is below normal.

"But now comes a point which may explain these symptoms without evidences of traumatic neurosis. This man has a lot of posterior synechiæ which refer most probably to a former iritis, although in the left eye there is a considerable amount of pupillary membrane adhering to the anterior lens-capsule. The condition might perhaps be a fœtal remnant. Ophthalmoscopically his right papilla showed quite a marked capillary hyperæmia, while in the left eye this was less marked. The retinal vessels were anæmic. This condition is most frequently found in alcoholics and heavy smokers. Having made these examinations, during which he would, with singular alertness, sit down, get up, turn around quickly in the dark room, etc., I questioned him regarding the case from an historical point of view. I heard now that he claimed to have been blind for a time during his illness (this was a lie, as he had never made any assertion to any physician in hospital or to any one regarding this condition). You see, my dear Doctor, I have examined this man totally unbiassed. Neither does he know what I did, nor what I did it for, although he was not only eager to have me tell what I had found—in fact, I had quite a discussion with him about his right to know what I had found—but he also wanted to carry my letter to you, and stated that to-day it would be too late. The condition of these eyes, then, does not, I think, prove anything for traumatic neurosis. My personal conviction, which, of course, does not go for much, is that the man is neither a total malingerer nor a school example of traumatic neurosis. I should like very much to examine his eyes once more with you personally present. ADOLPH ALT, M.D."

The reason we introduce this examination is to indicate that under ordinary circumstances an imperfect examination would probably have indicated contraction of the visual field. But the previous vision shows that contraction was attempted, and was not the result of his injury.

This individual was injured by being caught upon the pilot of a locomotive going at a rapid rate, and thrown some fifteen feet in the air over a passenger-coach. He was completely turned over in the air and alighted with his buttocks upon a pile of lumber some twenty feet distant. While he was a little dazed, as he expressed it, at the time of the accident, yet he clambered down and averred he was not much hurt; and he continued work for some two weeks before any trouble was manifest. He had an alcoholic history, and was an excessive consumer of tobacco. All through this case many of the plainer evidences of traumatic hysteria were more or less present. He had the fibrillary tremors of face and hands; he had periods of hyperidrosis; his pupils, of course, were contracted incidental to a previous lesion. Hysterical seizures were never manifest until the ninth month after his injury. He was able to balloon his abdomen any time he desired. This was done upon all occasions when he was observed. His face always presented an unwrinkled front; while pale, it was never pained nor pinched with care. He had a monoplegic right leg; the foot was dragged true to a case of this kind. He claimed an inability to perform co-ordinative motions, but this was unfounded, for he could perform many. There was never any marked disturbance of circulation. There was more or less progressive improvement as regards the accumulation of flesh. After he became able to walk with crutches, he always stood in a classical attitude, the affected limb being held up while supporting himself on crutches. Told to walk without crutches, there was an utter inability to accomplish this act, which was plainly not the work of a malingerer; there was every indication of positive fright and apprehension with incoherence of movement, an effort too intense and reckless to be simulated by any one.

Notwithstanding the fact that this individual received compensation, and now walks apparently very well, we are thoroughly convinced that this was neither a case, as expressed by Dr. Alt, of total malingering, nor a school sample of traumatic neurosis, and the resultant of traumatism along with a predisposition, namely, alcoholism.

Continuous discussion has been indulged in regarding the value of this symptom to disprove simulation. Many writers assert that its value has been overestimated; some believe that it can be simulated; others that it is a typical hysterical symptom, and not to be found in a neurasthenic condition. Willibrand asserts that, by varying the examination, simulation may be excluded. Bruns argues that some place the cases as described by Oppenheim on the same plane with those of simple neuroses, in which visual narrowing must be expected, as the trouble is not central. Such cases have brought about great confusion. Eisenlohr takes the same stand. Again it is asserted that upon repeated examinations the patients become educated and are competent to simulate this symptom. According to Guillemand, Wallenberg says: "If in the case of hysterical patients with contraction of the visual field we draw this visual field on a chart, and if then, by progressive removal of the patient, we augment the distance of fixed points, we observe, in most cases, a slow but perceptible increase of the field, which in most cases is not in proportion to the increased distance. In certain cases even these limits do not change."

Certain it is that there are elements of confusion as regards this symptom; the same condition of vagary surrounds it that surrounds the consideration of any single symptom. It would certainly appear to be pre-eminently common sense at all times to properly group the various symptoms, both subjective and objective, giving each its proper and respective value. We have seen cases of traumatic neuroses which have been diagnosticated almost entirely upon the presence of visual contraction and the Mannkopf sign.

The Importance of a Complete History of Cases.

The full history of a patient is of paramount importance to the physician. It is with knowledge thus thoroughly obtained that satisfactory diagnosis is accomplished, treatment rendered intelligent and judicious, and prognosis made reasonably sure; and thus the competent physician is enabled to fulfil the highest and best function of his calling. It is particularly necessary to note every incident in connection with the case, taking especial note of the character of the patient, and the presence of any scars, deformities, or other marks which existed prior to the beginning of the trouble under consideration. Indeed, we have found it of especial value at the first examination to have every point carefully written down, and no element of history left out. An imperfect history, particularly in traumatic neurosis occurring after railway accidents, certainly robs the expert of the very points upon which his deductions should be based.

As a rule, the fact of a person having been a passenger on a railway train in an accident is taken as sufficient evidence and cause for the production of traumatic psycho-neurosis. It is rare, indeed, for the expert to take any other statement than that of the patient regarding the manner of the infliction of the injury, even though he knows—none better than he—the extreme and thorough unreliability of statements made by neurotic individuals. There may be justification for this in the accepted idea that it will not do to conclude that the blow should be severe to produce permanent injury. It is conceded that seemingly slight accidents may bring on severe symptoms in those predisposed to neuroses; but an experience of many years among those devoid of predisposition, particularly among the young and physically well-developed employees, show that such results are due to predispositions. Nor do we believe that they will occur in the healthy and strong passenger unless intense force and well-marked predisposition concur. The expert seems too prone to classify his cases according to accepted authority, losing his individuality as an observer in order that he may reconcile existing theories.

Each case should be considered upon its own merits. Its history should be obtained from all sources, be it from the employees of the company or elsewhere, and properly sifted and considered. Certainly the investigation should also include the history of the individual before the accident, since it is always of value in such cases; for when the examiner proceeds without it, often many elements are missed which would enable him at times, at least, to qualify his prognosis. A true history places the honest expert in his just position, and oftentimes debars the possibility of his appearing to be a prejudiced partisan, when his position is pre-eminently a judicial one, favoring neither one side nor another.

General Features of Examination.

Since it is true, when individually considered, that there are no objective signs at present known which cannot be simulated, and that the symptoms as found in traumatic hysteria, neurasthenia, and their combinations, are found as frequently in the non-traumatic forms of these diseases, either inherited or acquired, good sense indicates that neither the objective nor subjective symptoms, taken alone, could be sufficient to establish the existence of a case of traumatic neurosis.

Concentric narrowing of the visual field is considered by many authorities as the best sign with which to disprove simulation. Yet this condition exists in non-traumatic hysteria as well; and it is doubtful whether its true and absolute value has yet been proven.

A proper grouping of both objective and subjective symptoms is the only just and proper method.

The patient's statements, when taken down, not infrequently make an accurate history of conditions which he could not describe unless he had been thoroughly posted in a neurological way. Many persons attempt to read up on the subject; and in our experience we have met with several who were comparatively well posted. Among the latter was a lady who had become a very good student of Erichsen, especially in his statements of the amounts awarded as damages. In the discussion during settlement with her, poor judgment allowed her to indicate the number of pounds which had been paid in compensation upon such and such an English road, by which she desired to draw a comparison to show that the compensation offered her was inadequate upon the basis of English compensation.

It will be found that attempts to educate lady readers upon this subject are a good deal like attempting to make a competent surgeon out of an engineer; that is, it is impossible to make a scientific person out of an unscientific one by the simple reading of a book.

In our experience we have never had any difficulty in dealing with persons of this character. The true line of honest, unprejudiced investigation based upon the scientific data seems at all times competent to expose them. We believe, with Oppenheim, that all kinds of disturbances of the mind can be simulated. "The theatrical presentation of Lear, Ophelia, and others have proved this. In spite of this fact it will not enter the mind of anybody to refuse the value of objective symptoms among the signs of the psychosis. Good actors are very rare, and have acquired their merit only after long, laborious, and deep study. Among artisans and laborers, I do not think there is anything more difficult to simulate, even approximately, than psychical disease."[1] All authors direct that leading questions should be avoided, as suggestions are received with unusual rapidity, and interpretations of them are sometimes made by the patient that indicate an astounding activity of mind. Where a question can be avoided, it should be at all times done; because the unstated evidence presented is of more value than when stated by either a weakened intelligence or the acumen of a malingerer.

---

[1] Oppenheim on "Simulations in Traumatic Neurosis," Berlin, 1891.

THE DANGERS OF LONG-CONTINUED AND MULTIPLE EXAMINATIONS.

In examining patients really suffering from traumatic psychoneuroses, too little judgment is often used regarding the length and exhausting influence of the examination. The expert in his eager devotion to his calling not infrequently prolongs his examination to such an extent that harm is produced. We have seen examinations made which would tire a strong man. Hence, we maintain that no examination of a case of this character should be made long and exhausting; nor can it be made in one day. The expert should proceed with all due caution, and aim to study, as near as possible, first, the mental condition of his patient. The results of each examination made should be noted, though but little be accomplished at each sitting. Due consideration for the patient's feelings will certainly render more plain the condition of the patient than when the matter is overdone. Exhaustive examinations frequently mask or intensify symptoms. We should always bear in mind that the disease receives at least some of its nutriment from suggestion; and suggestion may come not alone from words, but from the actions of the examiner himself. We do not believe that any individual poorly posted as a physician should attempt an examination of these cases. From experience, we have arrived at the conclusion that multiple expert examinations are prejudicial: we do not mean many examinations by the same observer, but multiple examinations by specialists. Thus, upon more than one occasion, desiring to be unprejudiced, and hoping to get intelligent assistance, we have sent our patient to the oculist to have his eyes examined; to the aurist, and the heart and lung specialist. And we have invariably found that the tests which were employed by these various specialists did little to elucidate or unmask imposition, if such existed, and in cases of true traumatic neurosis our patients were left in a much worse condition. Certain it is that the suggestions received in these cases by the multiform examinations rather clouded than cleared the case under consideration, producing confusion, not only as far as the psychic condition of the patient was concerned, but as far as the physicians themselves were concerned.

A STUDY OF OBJECTIVE SYMPTOMS—FACE.

In beginning the examination of a supposed case of traumatic psycho-neurosis, it is well to consider the objective symptoms mainly first, although we have the constant blending of subjective elements with them, and a complete separation cannot always be perfectly accomplished.

First, naturally, we should notice the facial expression. This is varied as a rule, and seemingly dependent upon the character of the trouble and the period of examination. Where neurasthenic symptoms prevail, we frequently find the face presenting extreme paleness, deep sunken eyes, and a pained, careworn expression which conveys the idea at once that the individual is a very sick person. Naturally, there are various gradations of facial expression. Now and then the countenance does not seem to present much change, particularly as regards emaciation. The value of facial expression depends upon its virtue as an objective sign where it harmonizes with other symptoms. The assertion is constantly made that it is easy to simulate here; still with this symptom, as in the study of all other objective symptoms, its value depends upon the acuteness and good sense of the examiner.

GAIT AND ATTITUDE.

The body of one suffering with this trouble is held in an abnormal position, stiffly bent forward in trunk flexion, an attitude apparently dependent upon the effort to avoid movements of the spinal column. Gray[1] says: "The attitude, the movements in sitting down and rising, the peculiar effort to effect a voluntary movement, and the gait, are all characteristic, as Oppenheim first had the acumen to observe, although I myself noted the same thing in many cases without it having occurred to me that there was anything distinctive about them. The body is held anxiously fixed, the spine bent stiffly forward; in sitting down or rising the patient seeks support with his hands, and he changes his attitude slowly and carefully. Oppenheim[2] attributes this mainly to the rigidity of dorsal muscles, and in lesser degree to instinctive avoidance of movements of the vertebral column; and I think his explanation is thoroughly accurate."

---

[1] *Loc. cit.*

[2] *Loc. cit.*

It is useless at this time to give the various pathological gaits described by authors, as they have been partly considered in another section, and as many may arise from more or less pretence or exaggeration dependent upon psychic peculiarities of the individual. As a rule, the legs are spread wide apart, with cramped, short, slow steps, and with lessened movements of some joints. Oppenheim says: "From the superficial resemblance of the gait to that of spastic paresis, we are able to make a differential diagnosis. There is an abnormal position of the body; in the fixed spine and forward trunk flexion commonly one hand is held on the sacral or hip regions." In unilateral paresis, the gait disturbance is one-sided, the patient supporting himself on one leg or with a crutch, while the other is completely motionless, suspended above the floor; the foot touches, and is dragged along.

In an endeavor to elucidate the existing soreness and rigidity of the back, which is considered as being the controlling factor in gait and attitude, it is proper and important to determine the exact condition of the back. In sixty per cent. of these cases arising from railway injuries, back symptoms are complained of.

F. X. Dercum[1] has done much in this direction; we shall not apologize for freely quoting him in regard to the proper and true method of making these examinations. Briefly condensed, his method is as follows: Note is taken of the position in which the back is held, observing whether the shoulders are held on the same level, the presence and relative amount of curvature, and the existence of muscular tremors. The first test is by palpation, where the hand is placed lightly upon the back of the patient, observing whether the patient shrinks or not. This may indicate either the absence or presence of hyperæsthesia, or a disposition to simulation. He says that if hyperæsthesia is present it is highly probable that hysteroid symptoms will be found in a further study of the case. The value of hyperæsthesia as a symptom he considers very small. The second test is by pressure, which he divides into deep and superficial. In superficial pressure the finger-tips or the palmar aspect of the thumb are used; graduating the pressure used, it is passed up and down the spinal column. This test, as is well known, may elicit in certain cases flinching or other reaction, as though pain was experienced, especially when pressure is made over the lower cervical, mid-dorsal, or dorso-lumbar regions, over the lumbar region itself, or over the end of the coccyx. This symptom, as he states, is commonly found in neurasthenia, especially in that form known as spinal irritation; and it may be found when hysteria accompanies neurasthenia. The next test is deep pressure by the thumb, stress being laid upon the application of its palmar aspect. The degree of force is varied as desired. The soreness present, when elicited by deep pressure, is generally more diffuse, and may be found on both sides of the spinal column, or even over various muscles of the back. When the desire is to elicit pain, not by force of blows, but by a faint and yet decided jarring, the percussion hammer is used for striking a number of very rapid, but not hard, blows on the spine of the vertebræ. Next the test by motion is used, which is divided up into voluntary and passive motion. The patient is made to bend forward toward the observer, and the manner in which the act is performed is noted, at what stage of the flexion pain occurs, and whether muscular spasm or rigidity is excited. Then the patient is caused to perform lateral flexion. When there is doubt, the trunk is forcibly flexed to the right or left side, without warning the patient. In another test used, called forcible rotation, an assistant kneels before the patient and firmly grasps his hips, while examining surgeon gently rotates the shoulders, thereby rotating the upper half of the trunk, to elicit evidences of deep-seated soreness or not. This is considered a very powerful test. Having failed to elicit any response up to this point, transmitted shock is applied. The patient is made to interlock his fingers upon his head; then by a sudden downward pull an impulse is sent through the spine. Of course, good judgment must be used as regards the amount of force exerted. If it is desirable to eliminate the cervical portion of the spine, the patient may be seated and the impulse transmitted through the shoulders. Another test, which is less valuable than the others, is causing the patient to raise himself on the toes and then let himself fall heavily back on the heels.

---

[1] *Loc. cit.*

While generally commending these tests as given, we cannot but think that they should be used only by the competent specialists. Again, any one who has made a study of this subject realizes that these examinations, particularly of the back, should be made with the utmost caution.

Locomotion and Tests for Co-Ordination.

The multiplicity of tests which are used in attempts to verify diagnosis are useful at times, if followed out legitimately; but undue rapidity creates confusion. We do not believe that it is either sensible or proper, in the application of these tests, to take one examination as the sole criterion. Frequent comparisons should be made. Muscular power may be found to be more pronounced on one day than another; yet this variation does not by any manner of means indicate pure simulation.

It is only a just comparison and study of the objective symptoms and their blending with subjective symptoms that can lead us aright, and we believe the simplest tests are always the best. Those which are naturally performed by the patient, and without too much display, are to be preferred. We should particularly notice the manner in which a patient walks where extra muscular exertion is demanded, as in ascending and descending stairs. A comparison should be made as regards the degree of motor involvement; the amount of possible flexion, extension, and rotation of the joints of the inferior and superior extremities should be observed, aiming to determine what relative differences in the muscular use of the respective sides exist. The manner in which the patient rises from a sitting posture should be noted; if he uses his arms as a support, he should be made to rise from his seat without the aid of hands and arms. It has been suggested by Clevenger and others that a powerful test is made where the patient is directed to assume a supine position, and then made to rise without the use of his hands and arms.

The best test to determine the degree of the ataxic condition of a patient is to cause him to walk along a straight line with his eyes closed. Generally, persons in health can accomplish this with ease, while ataxic individuals try to protect themselves by throwing out one leg to maintain their equilibrium, or a very pronounced form of staggering is observed. Again, the patient's ability to stand with his toes and heels together when the eyes are shut should be tested to determine the relative degree of swaying from one side to the other. While this may be readily simulated, yet at the same time a relative idea may thus be had as regards the patient's ability to do this.

In testing the ataxic condition of the upper extremity, a test which is generally used is to make the patient shut his eyes, and with a long swinging motion of the arm he most uses, be it right or left, attempt to touch the tip of his nose or the lobe of his ear with the forefinger. In the act the relative degree of muscular incoordination is shown by the degree of uncertainty and wavering, or failure altogether to accomplish the purpose. The patient's writing may be examined to test the state of the extremity used. Though deficiency of muscular strength may be simulated perfectly, yet variations in this respect may constantly be discovered and very nearly correct conclusions arrived at with proper care.

Page writes much upon the abuse of so-called instruments of precision, and avers that they are more harmful to the patient, in consequence of their suggestive character, than they are helpful to the person examining. Gray asserts that the dynamometer is unreliable, and that he immeasurably prefers the hand grasp. He deems it more reliable in every direction, since the observer interprets by means of the sensation in his own hand. The patient should be made to grasp the examiner's hands over the knuckles and not above. Obviously a better idea of muscular strength can be thus obtained than with an instrument that varies in its results and is defective in construction. When using the hand-grasp, the patient can generally be made to use opposing movements; by talk and bantering a patient can often be made to indicate the actual degree of his muscular power. While only a comparative idea can be gained in this way, still it is infinitely better than to use an instrument whose indications are even variable in normal states, and rarely ever tell a truthful tale. Should it be desired to use different weights, the lighter should be first employed, progressing to the heavier. We have been accustomed to use a two-gallon bucket, and by filling or emptying this, an approximate idea of the muscular strength of both upper extremities can be obtained. The consistency of the muscles should be tested by feeling them during contraction and relaxation. Differences in size between the two sides, keeping always in mind whether the patient is right-handed or left-handed, should be noted.

The vasomotor condition, particularly of the involved extremities, should be studied. There may be a cyanotic condition of the skin of the affected side. Any difference in temperature between the healthy and involved sides should be noted. Œdematous swelling of the parts should be looked for; this symptom is more frequently found in the lower extremity than the upper. Œdema, cyanosis, and lowered temperature are especially valuable signs, though even these may be induced or intensified for purposes of simulation. Thus, in one case where an individual presented but slight evidences of œdema and cyanosis while in bed, after wheeling around the ward during the day in a wheeled chair, the cross-beam of which rested directly under the bend of the knee, at night the œdema and cyanosed hue and the cold feeling of the cutaneous surface were increased, showing plainly that physical conditions had intensified them. This patient had been under examination some four months and a half. He had perfect control of his feelings, for the various tests used indicated complete anæsthesia; but upon settlement all these symptoms disappeared with remarkable and unusual rapidity.

While examining the patient it should be noted whether excitement is engendered or not; whether redness suffuses the face and the upper parts of the chest in a series of flushes. At the same time it should be noted whether there is indication of impaired nerve function as shown in hyperidrosis. Guillemand says: "The weakness of the vascular tonus depends on weakness of the nervous vasomotor system, which reveals itself by a number of objective symptoms, easily appreciated even by an observer of small experience. We refer to the sudden intense redness which invades the face, the forehead, the ears, and the chest. It begins with a small red spot, which rapidly spreads and forms a kind of roseola, justly called emotional roseola. Belonging to the same class of phenomena, Oppenheim notes the occurrence at each excitation of the injured side of the body, besides dilatation of the pupil, a redness of half of the face, and not a pallor, as some claim."[1]

DISTURBANCES OF THE SPECIAL SENSES.

Disturbances of smell, taste, and hearing, being entirely subjective in character, are not considered of great diagnostic value, owing to the constant difficulty of proving or rather excluding fraud, unless previous acquaintance with the patient debars the possibility of it. Tests made to determine their involvement are generally unsatisfactory, as they depend mainly upon hearsay testimony.

---

[1] Guillemand, *loc. cit.*

Subjective sounds, such as whistling and buzzing in the ear; unusual acuteness of hearing, even to the most insignificant of noises, such as the ticking of a watch or clock, and various degrees of deafness are complained of.

In four cases of deafness occurring in cases of traumatic neurosis three admitted having been previously deaf, but stated that they were rendered much worse by the accident (Thorburn).[1]

DISTURBANCES OF THE CIRCULATORY SYSTEM.

The disturbances of the circulatory system are of great importance. Usually they are not directly under the will of the patient, though they can at times be more or less influenced by the will. While certain circulatory changes can be voluntarily induced, still the grouping of the various circulatory phenomena may be of great diagnostic value in the determining of a true case of traumatic psycho-neurosis. The influence of fright, particularly where it is severe, is manifested at once upon the heart, inducing what is termed "shock." As Page expresses it, cardiac paresis is manifest from the beginning, and is plainly the result of shock. Thus, under such circumstances, we find an enfeebled organ trying to make up in rapidity of beat what it has lost in force; there is a quick, rapid, feeble pulse, without tone, without strength. If this original state of shock continues, a paretic condition of the heart is produced which predisposes to frequent attacks of excessive palpitation. Thorburn, referring to vasomotor, trophic, and secretory symptoms, says that they are much less common than the sensory and motor phenomena of traumatic hysteria; but he believes, nevertheless, that we do meet with such symptoms due to hysteria, and to hysteria alone. It is equally true that they are at times entirely dependent upon a neurasthenic condition. Patients complain of palpitation from the most trivial causes of excitation, which induce a frequency of pulse which may vary from 100 to 160 per minute. In the examination of patients it is always important and proper to use systematic means of determining the exact condition presented. Thus, as pointed out by Page, when the pulse is counted at the beginning of an examination, never fail to count it at the termination of the same; for by this means we are enabled to ascertain whether there has been any variation in the interval. In fact, where examinations are made repeatedly, it is always well to start with the pulse at each examination; for by any extended course of examinations involving weeks or months, the pulse may afford an indication of the relative degree of improvement in tone of vessels which will constitute a basis for just compromise. When we find that the heart-beat is essentially the same whether the patient is in a completely quiet state of mind and body or not, we can draw our inference. But, as stated by Page, a perfectly steady pulse through the whole examination tells its own tale. In the process of our examination, if we find that fatigue and emotion influence and aggravate this condition, it is certainly more or less indicative of a neurotic condition. The rate and character and excitability of the pulse indicate the amount of disturbance of the strength and tone of the nervous system, and at times constitute the best signs by which to estimate the patient's actual condition. An antecedent history regarding the patient's circulation before the examination is an essential part of the history. The whole vasomotor system at times seems to be deranged, and hence to have lost its normal tone; and, as we have previously indicated, peripheral manifestations are important. Patients not infrequently complain of these disturbances, flushings, the alternate feelings of heat and cold, not only about the face and head, but in various portions of the economy. We shall not again refer to the diagnostic importance of the vasomotor conditions of the paralyzed extremities, which are manifested in cyanosis, differences of temperature between the normal and injured sides; but it may be said that, as a rule, in the parts over which will power is lost œdema occurs, as in one case of ours where both extremities of one side were more or less œdematous.

---

[1] *Loc. cit.*

Fibrillary Tremblings of Muscles of Face, and their Influence on Speech.

It has been asserted by Clevenger that fibrillary twitchings or tremors of individual muscular bundles cannot be simulated.[1] When these are confined to the face, they become particularly noticeable; those around the lips or eyes presenting a tremulous aspect, especially obvious when the person is agitated or tired. They seem to be under the influence of the emotion, and are always lessened when the attention is withdrawn. They are not confined to one side, but may appear stronger in either one extremity or the other. When the right arm is the seat of the tremor the writing of the individual is affected thereby, but then the test of writing is one of the most inconstant signs. These tremors, at times affecting, as we have before stated, the facial muscles, not infrequently involve the lingual muscles, causing more or less difficulty in speech. Simulation of speech defects is possible, and should not be regarded as always of absolute diagnostic value. Still, a careful study of them should be made if they are present.

---

[1] "Spinal Concussion," by S. V. Clevenger. F. A. Davis, Pub., Phila., 1889.

There may be slowness and difficulty of utterance; it is not infrequently scanning in character, uttered with slowness and difficulty; or utterance may be explosive. Again speech may be accompanied by deep inspiration or panting, as if fright or intensity of effort had induced a rigid condition. Stuttering itself is not infrequently found in these cases.

DIGESTIVE DISTURBANCES.

Digestive disturbances frequently supervene almost immediately after the accident, and may persist for a long time, or become the focus of a chronic condition. They are especially gastric in nature. Nausea and vomiting may continue with oppression after eating, pain in the epigastrium, and other symptoms pointing to disturbance of the innervation of the stomach. The tongue becomes coated, and at times thickly furred; constipation seems to be the rule, but at times the reverse of this may occur, in which diarrhœa or symptoms of relaxation are manifested. It has been asserted by Guillemand that pronounced and inveterate constipation is an unfavorable sign; it aggravates the neurasthenic dyspepsia, and renders the treatment more difficult and uncertain. General nutrition is positively interfered with, and strength is sensibly diminished. Emaciation occurs, along with which there is pallor. The general condition of the patient at times seems pitiable, indicating excessive functional trouble. The muscles become flabby; vasomotor disturbances are manifested in persistent coldness of hands and feet. According to Guillemand, Bouveret divides the gastro-intestinal atony of these cases into two classes, the benign and the grave. The benign form is that where general nutrition does not seem to suffer, and the subjective sensations are summed up in the idea of weight, fulness, sluggishness, cramps, and a ballooning of the epigastric region and hypochondrium. In the examinations made after a repast, gaseous distention of the stomach frequently occurs. There is not only meteorism of the epigastrium, but a gaseous resonance beyond the physiological limits. Upon exploration of the gastric contents by means of a tube, we find a notable diminution, or even a complete disappearance, of free hydrochloric acid during the whole time of digestion. He avers that complete absence is more frequent in the truly neurasthenic patient. The contents of the stomach are generally composed of mucus, meat, and bread. Two or three hours after the beginning of digestion there is the odor of butyric acid, and the stomach seems to empty itself very slowly. Not less than six hours after eating, it is found empty. In this first degree the secretion is more at fault than the movements of the stomach, and, to use his own words, this general anachlorhydria is rebellious.

In the grave variety, nutrition is more profoundly affected; strength is almost lost; pallor and emaciation supervene; the skin becomes dry and of an earthy color; the face languishing in expression. The wasting at times may remain stationary, or even increase, during many months in spite of treatment. Amelioration is very difficult and slow, and relapses occur very easily. This is the period in which the patient is tormented by vivid hypochondrial prepossessions. Upon analyzing the gastric contents the same results are found, only that secondary acid fermentations are more pronounced. The secretions suffer, and there is atony of the stomach which seems to be peculiar to this variety. Even six hours after meals food is still found in the stomach. The muscular coat of the organ and its walls yield, and the cavity dilates; in fact, a splashing stomach-sound may often be obtained several finger's breadths below the umbilicus. The great curvature of the stomach may mark itself on the emaciated abdominal walls, producing a fold of skin at variable distance between the umbilicus and pubes. Guillemand names three complications of the grave variety: first, pseudomembranous colitis as a consequence of constipation and atony of the large intestines; second, dilatation of the stomach; thirdly, enteroptosis, of which the symptomatology is well known. This appears to be more frequent in women than in men. In the former it is necessary to add to the manifest influence of emaciation and gastric dilatation, relaxation of the abdominal wall and of the suspensory ligaments of the viscera, the predisposing causes of which are repeated pregnancies and the wearing of very tightly drawn corsets. It is well known that these two latter influences would suffice to produce the trouble itself. Emaciation, constant lack of appetite, gastro-intestinal troubles, vascular disturbances, and psychic anomalies certainly attest the reality of the affection.

The general disproportion here between the objective and subjective symptoms, while having no real value for the discovery of simulation, will certainly put the expert on his guard.

THE TESTS OF SENSIBILITY—THEIR VAGARIES.

Oppenheim states that contradictions in the examination of sensibility are always found, because we do not examine with an excitant of a uniform intensity, and because the attention plays a constant and important part. Cutaneous anæsthesia, according to Hirt,[1] varies in its seat and extent so much in the same individual that frequently repeated examination may give different results. Again, according to Oppenheim, in irritable persons where attention is quickly fatigued or weakened, the same stimulant in the same place during the same examination is not perceived, or perceived in an intense manner, according to the attention paid by the patient. Thus, for example, a patient who does not feel pain as a result of a prick capable of producing it, and who under the same influence has no reflex movement, may at another time react violently at the same point. Simulation is not necessarily indicated by this.

In the line of this last assertion, a case of so-called traumatic psycho-neurosis is in point. Under examination a pin was thrust into the thigh, and a very prompt reflex followed, the movement thus excited being not less than a foot in height. The following were the conclusions drawn by a professional *confrère* to disprove that there was any element of simulation present: "The results obtained by the pin experiment certainly prove that serious destructive myelitis existed, preventing, so far as could be determined by the doctor, any sensation of pain. When the pin was thrust into the patient's leg the exalted reflex gave a movement, as stated by the doctor, of about one foot in height. This is exactly what might be expected when we reflect that the reflex centres were no longer under the inhibitory influence or control of the will." This patient had, for four months after an injury, been in a paraplegic condition. At no time during these four months had he been observed to move his inferior extremities. The lower extremities were cold and cyanosed. Here were conditions which plainly pointed to organic lesion. He settled with the company in the forenoon, and left on the evening train. He lifted the leg up which had not been lifted for four months and put it on a valise in front of him. On arriving at his destination, he walked out of the coach unassisted, and from that day to this he has never had any symptoms of paralysis.

---

[1] "Diseases of the Nervous System," *loc. cit.*

Notwithstanding the seeming difficulty attendant upon determining conditions of sensibility, their many contradictions and their confusing elements, yet, if considered carefully and calmly, they tell a great deal. Goldscheider[1] recommends the following plan of deciding between actual and feigned analgesia or hyperalgesia. The indifferent electrode attached to a faradic battery is a large metal plate, and the other a long wire brush, the latter being placed in such a manner that half the length of the brush rests on the unaffected side, the remainder upon the part said to be numb. With a current strong enough to cause pain, the electrode is slightly raised from the normal side without the patient's knowledge; cessation of pain necessarily follows if the skin still in contact with the electrode is analgesic. Gray[2] well summarizes regarding the senses of touch, pain, and the temperature, and we cannot do better than to quote him. He says: "In testing the sense of touch, the ordinary method of employing rough and smooth objects and an æsthesiometer will not exclude simulation. The test by means of a pin or other penetrating object is not a test of the sense of touch, as it has been assumed to be in so many trials, but really of the sense of pain; and this is also true of the test by means of the powerful faradic current.

---

[1] Annual of the Universal Medical Sciences. F. A. Davis, Phila., 1893.
[2] *Loc. cit.*

The best medico-legal test of the sense of touch known to me is to lightly touch the patient upon the alleged anæsthetic area when his attention is diverted, or when his back is turned, due attention being paid to differences in tactile sensibility normally existing in the different areas of the skin, and to any possible marked degree of mental dulness. This simple test is extremely effective, and I have never known it to fail, even with the best-informed malingerers; and it is especially useful in alleged hyperæsthesia. The best test for the sense of pain is a powerful faradic current. A very gentle current should first be applied, and should be gradually and carefully increased to a moderate degree, so as not to alarm the patient; and then, the physician's hand having been all the time kept on the current regulator, a powerful current should be suddenly turned on. Some means of measuring the strength of this current should be employed, so as to be able to reproduce it and allow the jury, if necessary, to test it for themselves. The strength of the current that is to be used should always be determined before the examination, so that care may be exercised to employ no more than will be necessary to cause a distinct and not extremely painful sensation. The test by means of a needle is extremely unreliable, even though that needle be concealed in the so-called *aigue-cache*, or hidden needle; for we must remember that hypodermic needles can often be thrust for inches into the tissues without exciting pain; so that it is a very easy matter for any determined person to accustom himself to burying a pin in his flesh, as is often done in jest by boys. The exact position of the alleged pain, and the attitude and gait, are frequently of great importance. If the patient marks out the pain in the distribution of a nerve, this is strong confirmation of the truth of his statement, although the converse of this proposition does not follow; for pain is often vaguely distributed in indubitable disease, so that the positive value of such a statement is great, while it has no negative value. The presence of the characteristic attitude and gait of sciatica and of traumatic neurasthenia, as it has just been delineated, would be of great value.

"A very efficient method of testing the temperature sense is as follows: The patient should be blindfolded; a tumbler or test-tube should be filled with cold water, a second with moderately warm water, and a third with water so warm as to be slightly painful but not to scald. The glasses containing the cold and lukewarm water should then be applied in succession to the portion of the skin to be tested, and the patient be asked to state which is the cold and which is the lukewarm. This should be repeated several times, when, if the patient has failed to distinguish the temperature of the water in the two glasses, some of the very hot water should be suddenly spilled over the alleged thermo-anæsthetic area, care being taken not to spill any water upon any portion of the skin that has not been alleged to be affected.

"I know of no test of the muscular sense that will positively exclude simulation. When a patient alleges that the sense of pain, the muscular sense, or the temperature sense is alone affected, while no claim is made as to any implication of the sense of touch, this would argue strongly against simulation; for any malingerer, except one versed in nervous diseases, would be most likely to insist upon impairment of the sense of touch. It should also be borne in mind that these four different senses may be affected in different diseases, either singly or in conjunction with one, two, or all of the others."

THE MANNSKOPF SIGN.

Rumpf, of Marbourg, has suggested the use of the Mannskopf sign for the verification of real neuralgia or tenderness.

When pressure is made upon the painful or tender region the patient's pulse grows more rapid in a few seconds, rising from 84 or 92 to 100 or 120 beats per minute. This increase lasts for two or more minutes after pressure is stopped; besides, the pulse becomes smaller during the test. He found this present in eight cases of traumatic and in four cases of non-traumatic neurasthenia, absent in none, and he claims to have detected one malingerer by this means—the pulse did not rise during the test and the patient confessed later. He proposes to call this the neuralgic or traumatic cardiac reaction. Secondly, he uses quantitative reduction of galvanic excitability of motor nerves. Thirdly, faradization of the nerve trunk, fibrillary contraction of the muscle being found to last some time after the operation. He states the number of true neuroses is small; more than thirty-three per cent. are hysterical, ten per cent. are malingerers, and not more than five per cent. suffer from permanent disease.

Regarding the value of the Mannskopf sign, we are free to confess that we have met it in conditions where psychic troubles are not manifest, and we think that it will be found to exist particularly in cases of subluxation of the vertebræ.

The Influence of Compensation upon the Clinical Features of Railway Injuries.

The influence of compensation upon personal injuries arising from railway accidents varies with the individual. The hope and surety of compensation might possibly arouse in one man a spirit of inactivity, in another the reverse. Page, in the consideration of the influence of compensation after railway injuries, says: "Suppose, however, that compensation is to be awarded for every ache or pain and for every day that he is absent from his work, it is only natural that the keenness of his desire to resume work should be very much diminished. If our hospital patients were to be compensated, we may be sure that the features of many a case would be completely changed, and that the whole clinical history of a disease would wear a very different aspect from that which is usually seen; and changed for the reason that compensation acts as a let and hindrance to the natural and the very necessary effort which each person must make for himself toward convalescence and resumption of work. It may do so quite unconsciously; for the knowledge that compensation will certainly be paid him for the injuries sustained in a railway accident tends from the first day of illness to give a tone to his feelings and to effect his own impressions of the sufferings which he may have to undergo. He is less likely to take a hopeful view of the future, is more prone to be despondent about the prospects of his recovery, and in so much will his own personal efforts be weakened. It is well that this matter of compensation has no place in every-day hospital practice; and you will always do wisely, in endeavoring to form an estimate of the cases which involve medico-legal inquiry, to revert to your hospital experiences, and to recall the usual history of your hospital patients, both as to suffering and disablement and the prospects of recovery."

We cannot agree with the idea in general. Any one who has had experience in this class of injuries in this country has learned from daily contact and treatment that more or less exaggeration enters into any case; it would appear to be nothing more nor less than human. But how the soothing elements of an assurance which certainly placates irritating circumstances can in any manner hurtfully change the clinical aspects of any case, we cannot clearly see. The writer has for years been in charge of a hospital wherein every injured patient has, from the time of his entering into hospital until cure, the assurance of more or less compensation (these patients numbering hundreds annually); and if it could be computed with absolute correctness, it would be found that, as an element aiding cure, its efficiency is as great as almost any factor in the treatment. Take as an illustration the laboring class, the employees of a railway. It is an almost invariable rule that they belong to some benevolent or protective organization which gives compensation during disability. Aside from this, compensation is paid them by the railway company for damage inflicted; and yet the mental tone created does not superinduce except in the rarest instances inactivity and turpitude, nor unduly exaggerate the term of prospective disablement. Granted that in isolated instances the reverse occurs, still it is certain that when irritating mental elements are eliminated, the best possible condition of mental rest is produced, and the natural recuperative forces have the best conditions to act. Compare if you will the opposite condition. Suppose the injured individual has a large family. Upon the receipt of his injury he knows that his means of supply are stopped; he sees prospectively before him a long siege of suffering and permanent disability, with no hope of bettering his condition, and the suffering of his family incidental thereto. Here at once we have created debilitating and disheartening influences inducing a morbid tone almost from the beginning. How the establishment of hope, assurance, and placidity of mind, and the withdrawal of a great deal of irritating circumstances, can make an individual "tend from the first day of illness to give a tone to his feelings and to affect his own impressions of the sufferings which he may have to undergo," giving him a less hopeful view of the future, and making him despondent about the prospects of his recovery, is certainly not clear, nor do we believe it; for our own experience indicates just the reverse. If compensation brings with it many elements of mental comfort, certain it is that the mind has been healthfully stimulated and soothed; and its response will be a manifestation of a more rapid return to convalescence than where the opposite condition exists.

There *seem* to arise incidental to the infliction of a railway injury many abnormal conditions, which are not to be found outside of railway injuries, while those inflicted by other agencies are at times essentially the same; but guided by the experience we have had, we do not believe that the qualifying term "railway" can and does subvert the eternal order of things. Compensation might, as we before said, be incidentally hurtful to some, but it is not natural to have it act so. To the young, to the practical, common-sense man, to the active man, to the man accustomed to outside life, to the railway man accustomed to open air and constant change, the narrow confines of a hospital life and the cramped conditions of medical treatment certainly will not possess many elements of pleasure. Compensation cannot in a brief time change the entire mental organization of man. The cupidity of some men undoubtedly makes them attempt to unduly lengthen out and exaggerate their condition; but if this is met by intelligent medical treatment its results are easily overcome. Viewed by one who has studied its effects under all of its varied aspects, compensation cannot appear in any other light than beneficial. We cannot see how it possibly produces effects other than as indicated. Of course, we can readily see that if these individuals should get sufficient compensation to assure them of opulence in the future, the result might be that described by Page; but in every-day life, where compensation is given upon a basis of justice, its effects certainly are beneficial.

We have often thought that had Erichsen, in his graphic and classical work "On Railway and Other Injuries of the Nervous System," confined himself to clinical description, his work would have stood in the light which its merits deserve. But when he gave the details of the monetary consideration received in each case, he aroused the cupidity of the world, and detracted from the pure scientific character of his exposition. The damages awarded were enormous, and before undreamed of. We read: "The question of damages resolved itself to a great extent into one of loss of income and expense incurred. The jury awarded

£5,775;" or "the plaintiff recovered £6,000."[1] In this country, owing to the example quoted, damages have been awarded in this class of cases as high as $49,000. From this on, railway spine and railway brain became speculative troubles. Not a physician read who was not impressed; dishonest ones not only supplied the legal side of the question with its medical data, but invariably pointed to the financial side. No medical book ever written has been more extensively read by the laity; and none certainly has ever been more closely studied. It has been the means, by its plain, graphic description, of educating more malingerers than any single book emanating from a professional mind. It has been the foundation of "compensation." If the "baneful effects of compensation" lead to the production of marked psychic anomalies, the story of the awards of damages, first detailed by Erichsen, first plainly emphasized this factor, and make it a disease-producing element. In describing a new trouble Erichsen made operative a new influence, which, in its turn, is oftentimes more serious in its effects upon the psychic condition of injured persons than traumatism itself.

MALINGERING—A GENERAL CONSIDERATION.

Robert Farquharson[2] says: "While proceeding in the examination of a case of supposed malingering, due caution should be observed. The practitioner must endeavor to hold the balance between an excess of suspicion and a too credulous attitude, remembering that the good of society and of the public service must be fairly considered; while all care must be taken not to confuse the innocent with those whose ingenuity has occasionally enabled them to feign. Again, the progress of science and approved methods of diagnosis have rendered the task of the impostor difficult, if not well-nigh hopeless. Feigned blindness can hardly resist the test of the ophthalmoscope. Electricity will clear up many apparently anomalous nervous symptoms. The stethoscope and the sphygmograph will tell us the real condition of the heart; and careful observation will detect rougher attempts to deceive. Again malingering may often be exposed by examination under chloroform or ether. We are not likely now to be taken in by a piece of liver tied to the breast to simulate a cancer, or by an artificial nasal polypus; and although diseases and ulcerations may be kept up by local applications, we only require a suspicion to cross our minds to put us on the right track for discovery."

---

[1] Erichsen, *loc. cit.*

[2] Quain's Encyclopedia Medical.

Dr. Farquharson's directions are thus freely quoted, because for a number of years they have been our guide; and they have been the means of enabling the writer to expose a great number of malingerers. We should much rather have a thoroughly competent, guileless, and unsuspicious physician or surgeon examine a case wherein elements of malingering were manifest, than a prejudiced, suspicious, and biased physician. If the true lines of diagnosis are adhered to, the malingerer will be completely thrown off of his guard by the absolute manifestation of honesty upon the part of the examiner. The malingerer will almost unwittingly expose himself in some exaggerated manner. But the physician who starts from the beginning with suspicion and prejudice, unless he is a marvellous and unusual character, will show almost unconsciously the prejudice that is in him, and just in proportion as he makes this manifest will the malingerer protectively defend himself. It is not a mistaken assertion to make, that honesty when facing dishonesty is, as a rule, competent to confuse the latter; naturally and obviously because the malingerer's methods are all predicated upon dishonesty, and it simply confuses his line of thought, when his assertions are taken as true and proven to his face as false.

We do not propose to enter into an extended dissertation regarding the general moral character of the malingerer, except to say that he is frequently of a low moral tone and usually incompetent mentally to appreciate the best elements of study or thought. Again this desire to cheat or defraud in many cases has been inherited, or rendered acute by some predisposing or acquired disease. Many cases constantly come under the observation of the physician where deception is the result of pathological conditions; such patients are pathological liars, and they should not be held as gravely responsible, since the condition is the result of a disease. This deception is at times involuntarily made in consequence of some diseased nervous impulse. Again, there are persons who have inherited immoral elements of character; such persons lie naturally, because they have honestly inherited it from their progenitors. They are physiological liars; it is as natural for them to lie as it is for them to breathe.

The malingerer who, in consequence of a lowered moral tone, deliberately sets himself to work, in well-considered and deliberate order, to make or establish his deceit, is generally a malingerer who is to be the least feared of all sorts and kinds of malingerers; because, as a rule, his dishonesty is rarely competent to defeat honesty. After many years of experience in this kind of work, we are thankful for the fact that very few malingerers successfully deceived us; but with exaggeration of symptoms, our experience has been the reverse. In one portion of this work we have already referred to the influences that are injurious to a true case of traumatic neurosis; namely, specialistic examinations which seem to increase and intensify an already existing neurotic condition; but for the detection of the true malingerer nothing has equalled specialistic examinations; for they debar the possibility of the assertion being made, as when only one examiner is used, that the examiners have been prejudiced.

To better show this point let us give an illustration. An individual was blown up by the explosion of a steam dome, as he claimed, some fifteen feet in the air. He sustained a contused and lacerated wound at the middle portion of the supra-orbital ridge, wherein the supra-orbital nerve was plainly injured. He received diverse contusions about his head and back, and claimed that his perineum had been so injured as to cause stricture of the urethra, necessitating the employment of a catheter for some time. In addition thereto, he received scalds on the inner side of right thigh. After an enforced rest for two months, he claimed that he had partially lost his hearing on one side, and completely on the other; also, that his eyesight was so interfered with that he was incompetent to read, and at times became almost blind. He complained of a difficulty in breathing, and that an excessive palpitation of the heart at times incapacitated him. At the same time, he claimed an utter inability to void his urine as he was wont to do.

With an honest desire that this man should not suffer in consequence of a prejudiced idea which we had gained in consequence of the physical appearance of the individual, he was sent to specialists. His countenance was clear, ruddy, and healthy; his eyes, particularly the conjunctiva, looked healthful, bright, and brilliant; there was no emaciation about the face or body; there was a brisk, energetic and business-like air about his movements; no signs of paralysis, except slight ptosis of right upper lid, owing to injury of the supra-orbital nerve on that side. The urethra was examined and stricture disproved at once. The heart and lungs were found healthy. The throat, heart, and lungs were examined by specialists, and a normal condition reported. The oculist made several examinations of his eyes, and reported the fact that the patient under consideration had no diseased condition present. The aurist, upon the fourth examination, showed to a number of people sitting in his office, and present during the examination, the utter falsity of the claim of deafness, to the patient's confusion.

This individual afterward declared that in his ignorance he had tried to make up this condition, but he was free to confess that had he known what he had to undergo he never would have attempted it.

SPECIAL CHARACTERISTICS OF MALINGERING AND EXAGGERATION.

It can be stated as a matter of fact that the simulator of traumatic neurosis will encounter continuous and positive trouble under scientific supervision; and we doubt the possibility of his succeeding, unless he shall have unusual knowledge at command. The greatest element of difficulty in the examination of these cases is to determine the degree of exaggeration, which at times it seems almost impossible to accomplish. If the time is limited in which an expert is compelled to work to make examinations into this trouble, the difficulty is proportionally enhanced. Right here is where many of the profession fail to place themselves in proper position. They will, without thought, at once accept these cases for examination, when the time afforded them is so short as certainly to debar the possibility of thoroughness. It would appear that common-sense practitioners should refuse to take the examination of a case until they had received permission to use what they conceive to be necessary time. It is by imperfect methods that truth is not reached; it is by imperfect examinations that the simulator accomplishes his ends; it is by these methods that expert testimony becomes a farce, instead of a potent factor in the detection of malingering. It should be remembered that in traumatic neurosis there are often hysterical symptoms, and a patient whose general reliability may not be questioned under ordinary circumstances, as stated by Page and others, in this condition is frequently the victim of his own deception; and that more than other people. This strange disease, to one not well versed in the study of its transitional stages, seems to constantly present elements of pretence. We are free to confess that one of the most difficult and seemingly impossible tasks to accomplish is to draw a dividing line between an hysterical patient's actual condition and the exaggeration. Its strangely irregular forms present scarcely a symptom that is not thoroughly and intensely exaggerated. Thus, we have not infrequently noted that a suggestion given by any one in the patient's presence, of having the semblance of some symptom, is immediately assumed. If the physician but remotely suggests any idea leading up to a symptom not already possessed, it is only a short time when this symptom will be strongly manifest. There appears to exist in the patients an acuity of intellect which is almost as marvellous as the receptive element of the brain. It would seem as though the patient's mind was intent upon the purpose of mimicking anything and everything pertaining to his diseased condition. A case in point will not be out of place. We believe this individual was as much a combina- of an injured man and a fraud as could well be devised.

The history of the case is as follows: The man, while on top of a car in motion, fell off the same backward, striking his back against another car some six feet below him, and from this to the ground below, where his head struck a tie. He was rendered unconscious at once and did not return to consciousness for nearly an hour. He was brought to the hospital some eight hours afterward. There were no external evidences of excessive shock, as manifested in cold, clammy, and contracted skin; the pupils of eyes were found dilated. The pulse showed shock, and was rapid and weak—130 per minute. He claimed to have voided his urine naturally after the accident, but after becoming conscious he averred that he could not move his legs, and that they were numb and tingling. Examination revealed obtunded sensation in irregular areas above anterior superior spinous processes of the ilium and down to the toes. There was no evidence of an external injury to the back. He spoke in a stammering manner.

Skin warm; no indication of moisture; retention of the urine, which continued until the fifth day. Twelve days after the accident there was sensation on the outer side of legs. He manifested thereafter more or less marked symptoms of an hysterical condition. On the forty-eighth day after his injury he became aphonic and complained that his eyes had become defective. Eighty-six days after his injury a peculiar symptom became manifest, which he stated he found out by accident. He stated that by pressing on a certain sore spot at the back of the head, about in the median line on the level of occipital attachment of the occipito-frontalis muscle, he would become totally blind. The aphonia continued along with more or less variation of defective vision, and at times he had hystero-epileptiform convulsions. The man was able to go about the ward while in a wheeled-chair after the third week of his injury, and continued to until the date of his discharge. An examination of his eyes was made by Prof. A. Alt, which is reported as follows: "I examined the man for the first time on March 22d. He stated to me that his right eye was totally blind, and his left one too poor to read with. He also stated that he could render this, his better eye, totally blind by pressure on his occiput. The following was what I found: outer aspect of both eyes normal; motility normal, pupils medium wide, reacting equally well to light and accommodation. Right optic nerve somewhat reddish, but outline sharp; arteries of retina thin, veins slightly tortuous but not then hyperæmic. Left optic nerve also slightly reddish, retinal veins somewhat tortuous. I then examined the spot which, when pressed upon, would render him blind. He gave it as lying to the left and a little below the protuberantia occipitalis, and when I palpated it, he stated that 'the whole neighborhood' there would do. In palpating the region I could neither find the evidence of a fracture nor a thin and perhaps elastic portion of the bone; and although I pressed hard, he did not get blind. I then had the spot indicated by him pressed upon while looking into his good eye—that is, the left—with the ophthalmoscope. No change in the filling of the blood-vessels occurred, but he promptly stated that he was now totally blind. Upon being asked how long this blindness usually lasted he said for about an hour. In spite of that he counted fingers at three feet correctly afterward, and wheeled himself back into the ward through a narrow and crooked passage with the greatest security. About five minutes later I let him count my fingers again. He now counted them at six feet, but kept his gaze steadily on them for a much greater distance, although he stated he could not see them. The state of his optic nerves not explaining his blindness satisfactorily, and having heard of examinations that had been previously made, I saw him again two days later. On being asked how he could see that day he said, 'Oh, very well to-day.' Upon making him count my fingers, he refused to see them any further than six feet from him, although again he kept his gaze steadily on them for a much greater distance. I then told him I had brought some glasses along which I was confident would make him see better. Placing my assistant six feet from him I let him count the fingers, which he did readily. While he did so I placed a prism of twelve base downward before his good—left—eye, when he said immediately, 'Now everything is mixed up.' I then asked him, 'Do you see one or two hands?' and he unhesitatingly stated, 'Two.' Of course if all of the facts here reported were not sufficient to arouse the suspicion of malingering, the prism test proved beyond a doubt that, with regard to the statements he made about his one-sided blindness, he was a liar."

There never had been any sign of motion of his paraplegic inferior extremities; besides, the parts from knee downward were cold, œdematous, and cyanosed. This patient received an amount of compensation which we were certain was insufficient to produce marked reaction. Yet within seven hours after compensation had been paid him he was able to use his œdematous and cyanotic limbs somewhat freely. At no period from that time on was paralysis manifest. A letter was written to this individual some two months afterward, inquiring concerning his condition. We received very promptly an answer in which he averred that his voice had returned after sixteen bones of various sizes had come out of his throat. We tried to obtain one or more of these bones afterward, in another letter, and, of course, failed. But he stated that his eyes were still weak, and had not regained their full strength. In the daily examination of this patient while in hospital, and the examinations made by four other *confrères*, the conclusion reached was, that the case was not one of pure malingering, but one of extreme exaggeration of symptoms, backed by hysterical elements. We cannot conceive how any mortal could have imitated and gone through with the various phases of suffering he manifested, unless there had been some morbid condition at the back.

SO-CALLED DETECTIVE METHODS OF DETERMINING MALINGERING.

In the examination of these cases it has seemed to us that the use of detective methods is seldom demanded. Such a method is the acceptance of assertions of outsiders who would claim, for instance, to have seen a paralytic walk, or who describe what they conceive to be the patient's condition. While this at times may appear to accomplish the purpose, yet we conceive it to be working upon an unscientific principle. We admit that in the attempt to discover malingering we are justified in proving the truth or falsity of symptoms in almost any convincing manner, but it has often occurred to us in our examination of these cases, that, if our knowledge and capacity were not sufficient to determine them, the various detective methods certainly would not.

It is a good deal like using indiscriminately and injudiciously anæsthetics in the investigation of these conditions. Thus, for instance, Guillemand says: "The question of using anæsthetics, having been advocated for a brief time, has been likewise rejected. Their employment is no doubt a little dangerous; and be the danger ever so small, we have no right to subject the patient to it. It was proposed to utilize the period of excitement preceding anæsthesia, or that following it, which is characterized by unconscious loquacity, in the hope that thus certain facts testifying to the fraud employed by the subject might be revealed. This means, aside from the possible danger it involves, is as unworthy of medical science as that which consists in obtaining a confession by the aid of intoxicants."[1]

We are free to confess that the use of anæsthetics, predicated upon the fact of obtaining warped and intoxicated utterance, is poor sense. But it is nevertheless true that such methods are justifiable in proportion to the dishonorable methods used by the malingerer. Where the physician has obtained a clear, explicit history of a case; where he has been placed in a position to know exactly the degree of force that produced injury; and where a patient clearly has the purpose to deceive, a resort to such means may be warranted.

Thus, for example, a man fell off a car, but, as stated by those who saw him, he did not fall sufficiently hard to hurt any one. He immediately became paralyzed, and was brought to the hospital. There were no evidences of injury present. The skin was of a healthy hue, eyes bright, and cutaneous surface warm. He was uncertain as regards every element of sensation. He had retention of urine, which was the only clear symptom present, and which we believe was feigned. He remained in this condition of paralysis for twenty-four hours, but laughed and joked with those around him. This patient was put upon the operating table, and ether was administered. During the anæsthesia it required two men to hold his legs on the table. As he gradually came from under the influence of the anæsthetic, his limbs were slapped, and in inelegant language he insisted upon being let alone. Then his limbs were gradually placed in a position for locomotion and he was made to walk. From that day on he never evinced any symptom of paralysis.

---

[1] Lauenstein has lately advocated chloroform narcosis as a means of unmasking simulated traumatic neuroses, and cites a case in illustration in which rigidity disappeared under the above test, causing him to conclude that the patient was a malingerer. Friedman contests Lauenstein's deductions and the value of chloroform narcosis. He cites the case of a man who had clonic splasm of the hands. These ceased during chloroform administration, but on recovery from the narcosis the movements returned. As a basis of his belief in favor of these rhythmic contractions originating in the brain cortex, independently of volition, he alleges that he produced suspension of athetoid movements in a paralytic by passing a constant current through the fronto-parietal regions.—J. A. Booth, M.D., *loc. cit.*

We have records of three cases of this kind, in which we were led to our conclusions by the physical conditions which presented themselves. One patient allowed that he had been "whipped" this time, but he had made a good "stake" before.

Again, we should not, under any circumstances, use an anæsthetic, unless our previous knowledge and close study of the case indicated to us that some rude shock was necessary to make a scheming mind realize that its lies were not believed.

We have never at any time used the subterfuge of visiting a patient unexpectedly, or returned immediately after making a visit, on the pretext that we had left something behind. Nor have we ever followed a patient, and, unbeknown to him, watched his walk and attitude. Beyond the use of an anæsthetic, we have never resorted to any means of torture to wrest from a patient a confession; if we were not able by an examination based upon purely scientific lines to accomplish our purpose, we never thought of other means. We can readily conceive that the proper use of a "Kodak" might give evidence of malingering; but still we think that the best manner to determine this condition is to follow a strictly scientific method of personal examination.

A Consideration of Precedent Diseases, or So-Called Substitution of Origin.

In the examination of cases of supposed malingering it is always pre-eminently proper for the examiner to take especial note, under the most favorable conditions of examination, regarding the appearances as they present themselves particularly upon the surface of the body. With honest and conscientious endeavor, it is never necessary to permit any prudery to interfere with an examination. The parts under examination should be freely exposed, but always gentlemanly and kindly consideration is demanded. If naked-eye lesions are manifest, we examine, compare, and obtain their history. In supposed joint troubles the regular rules of surgery are always sufficient to afford legitimate conclusions, the injured side being always compared with the normal side. It has been our privilege to put to confusion many assumptions of injury by following out the scientific line of examination. Thus, an injured passenger, claiming to have been hurt on a train which had become derailed, presented himself for examination, saying that the elbow-joint on his right side had been broken. Examination revealed an enlarged and diseased joint, giving all the evidences of chronic inflammation. He was accompanied by two lawyers and several friends. Upon comparison of the two sides it was shown to the satisfaction of all present that this person's injuries, if any existed, were not great; as he asserted, he had been subject to articular rheumatism. The two joints were in essentially the same condition, and not only this, but the knee-joints were shown to be involved likewise. While finding it impossible to prove that this injury had not intensified his rheumatic condition, he was settled with on the basis that probably his rheumatism had been increased, but not because there were any evidences of an injury having been inflicted. Owing to the fact of being placed in a favorable position for obtaining an immediate and correct history of these cases, it is rare indeed to have substitution of origin presented; certainly never with the employee, and only in those cases that are taken from observation. We have never been either confused by hernias, hydroceles, or orchitis. It has been our experience to meet with cases of uterine prolapse, but it has been easily and almost invariably shown by a precedent history that the assertions were false. Upon one occasion a woman in stepping off the platform of a passenger coach, which had started before she was fully off, claimed that in consequence of her accelerated motion a femoral hernia was produced. She was then in the eighth month of her pregnancy. A suit was entered for ten thousand dollars. After the birth of her child an ovarian tumor made itself manifest, and grew into large proportions. This, along with pregnancy, was shown to be the more probable cause of hernial protrusion than the accident. The suit was withdrawn without compensation, after the history of the case was evolved.

It is asserted by various authorities that such conditions as atrophic paralysis of the muscles of the arm dating from infancy have been presented as results of railway injury; but the shortening of the bones of the arm easily establishes the nature of the precedent trouble.

The most delicate question to determine, in the examination of the cases where lesions are present, is the extent to which the trauma has intensified the already existing condition. Rheumatism in persons subject to it may be intensified by injury; still it is rarely difficult to prove that the trouble dates back of the injury. In how far pain and enforced rest has been occasioned by the injury, is problematical; although, when it can be proven that precedent disease existed, there is a contributing condition by which the legal liability is of course lessened.

Usually the attempt to palm off various precedent diseases is made by those but poorly versed in medicine; and in our experience they are easily frustrated.

CHAPTER V.

A GENERAL CONSIDERATION OF PROGNOSIS.—ENGLISH, AMERICAN, AND CONTINENTAL AUTHORS.

A General Consideration of Prognosis.

At one time or another in the treatment of cases of traumatic psycho-neurosis the question invariably arises whether the disease is curable, and if so, in what period of time? What will be the influence of this trouble as regards the future capacity of individual hurt? Will he be permanently disabled or not? Will his earning capacity be destroyed? Is he only partially disabled? What are the chances? These questions constitute at times some of the most difficult points in the determination of cases of this character. Thus far, in the general consideration of subjects incidental to traumatisms arising on railways, we have given prognoses under their respective heads; but now, in the consideration of traumatic neurosis, our work is only half done without taking into consideration the elements and general opinions of authorities regarding this trouble. There is no greater discrepancy of opinion by writers upon this subject than on the subject of prognoses. It would appear that varying conditions have constant and manifest influence, and there can be no reasonable doubt that compensation is a factor which produces a great deal of this discrepancy, and a confusion in the minds of honest physicians, arising from the fact that no honest practitioner would wilfully desire to injure any one suffering from a supposed incurable trouble. Such doubt naturally indicates caution; it is indicative of the very best purpose upon the part of the just and honest practitioner. Among the most important causes for this condition is the fact of the extremely limited time which the majority of our profession have for considering this trouble. The treatment used, as a rule, is inadequate and improper and cannot possibly give a chance for a good prognosis. Also in the examination of cases in expert work, the time used is utterly inadequate to accomplish the desired result. This is particularly so in this country. It would not be a rash assertion to say that not one case in twenty is examined under conditions favorable to its solution.

It has always been with us an unexplained point in the consideration of this trouble, why we have so great differences between various writers on this subject. The assertions of English authors on prognosis are almost at the opposite extreme from the opinions prevalent in France and Germany. The observers in these various countries are perfectly competent and honest, and there must be some other determining factor besides the influence of compensation, and that of surroundings and favorable circumstance. It has constantly occurred to us that probably racial differences might solve the problem. There certainly must be some hidden influence which makes the vast discrepancy as at present indicated between the authors in these different countries. The greater bulk of cases coming under our own observation have been among the employees of a railway. We make no apology for quoting from our experience in this direction, as we honestly believe that they more truly typify the injuries occurring upon railways than do those of the passengers, as the conditions which cause them are constantly acting in a more violent form than with the passengers. Admitting that familiarity with dangerous surroundings and physical conditions are constantly modifying factors, still the discrepancy is too great even to have these influences produce it. There certainly cannot be any doubt regarding the influence of favorable surroundings, nor will there be any question regarding the reverse. The thought naturally arises where good results have been obtained, that where different results follow some defect must have existed either of heredity, treatment, or surroundings. To one having experience in litigation wherein railways are concerned, any seemingly erratic and unjust action upon the part of an injured passenger of a railway is never a surprise; because one invariably sees so many evidences of rank injustice that it finally comes to be considered a normal consequence which surroundings have created. Fraud is constantly manifest; injustice is very frequent, which even innocent persons are led into in consequence of the full force of existing conditions, where unprincipled and scheming persons use the injured passenger as a means to accomplish selfish and unjust ends, aided and assisted at times by honest, truthful, and competent scientific authority. Hence there is naturally aroused in the minds of physicians who have been fortunate enough to see the full force of favorable conditions in the treatment of these cases, a sense of great inconsistency. The part most to be deplored is the fact that honest and competent physicians are so often led astray in consequence of certain restrictions placed upon them; namely, the inadequate time given for examinations and the contracted demands of law. Thus, a medical question has to be answered that has been formulated by a legal mind; where a theory made in law forces the honest physician to answer in a thoroughly cramped, concise, and legal manner. It would seem as if the law were made, particularly in these cases, to force honest medical authority within the restrictions of legal conditions.

The positive influence of proper surroundings, as shown in hospital work, where we have even the elements of compensation acting in their most effective way, and where surroundings are made to act in their most favorable manner, can be plainly shown. It has been the writer's privilege to attend in the past thirteen years from five hundred to two thousand injured railway employees annually, and yet during that entire time he has treated only six cases of traumatic neurosis; and in this number there is not a single case wherein cure was not the result. The injured employee, in settling with the company, always settles upon a basis of re-employment, and generally continues in the service of the company; and if cure was not the result, certain it is a return to the hospital would be almost invariable. It is true that in some cases the treatment has been of long duration—in one case nearly eleven months; in another over five months, in another over four months; but generally much less time accomplishes the result. We have stated before that, according to the information which we have gained, in 73,539 employees injured, but eight cases of traumatic psycho-neuroses occurred, or one in 6,128¼. As a rule, these persons were injured under conditions more intense, forcible, and harrowing than those affecting the passenger. But we find that about one in every ninety-four passengers had this trouble. The difference is so enormous between the relative frequency of this trouble among injured employees and among injured passengers, that we cannot fully explain it. The writer does not propose to place his dictum against quoted authors, but has earnestly tried to give a truthful detail of his experience in connection with this trouble. It may be possible that our experience is thoroughly exceptional. We acknowledge the fact of our utter confusion in the wide differences given in consideration of prognosis in traumatic psycho-neurosis by the most competent opinions upon this subject. Compensation is generally considered by authors as not only baneful, but as an absolutely aiding and developing factor in delaying cure. Compensation (when not extravagant), as viewed by the writer, does not possess the incidental elements of worry and harassment that obtain when litigation is indulged in. There has not been a single case among employees where compensation has not been a consideration from the beginning. It is true that this element of compensation has not been in its most extravagant form, but it has always been a constant consideration, and has rested upon compromise and not litigation. We are free to confess that in our view the influence of compromise is great. It relieves the injured individual of all the attendant worries incidental to litigation; its influence is in the direction of mild, normal, and unruffled action. For many years we have always considered this in the treatment of our cases, indicating to the patient that if he would settle with the company the effect would be beneficial for him. It will be found that when compromise is viewed in all of its lights, its influence is invariably good; thus tension is avoided, and there are no aggravating states of suspense. Under such circumstances we look upon the prognosis as favorable.

THORBURN'S VIEWS OF PROGNOSIS.[1]

We find, after leaving out the element of compensation with the employee, that Thorburn's ideas verify our own. He says, "If, then, there be no pecuniary complications, and if the case be at once placed under proper treatment, we may apparently expect perfect recovery within a few weeks. If, again, the case be neglected, but the financial difficulty be still excluded, the symptoms appear to become more fixed, and a longer period, probably some months, may be required for an absolute cure. That in either case an absolute cure is to be expected appears to me almost certain, both from the above-quoted and other published cases. I am confirmed in this opinion by the fact that, whereas traumatic hysteria is by no means rare, I am unacquainted with any standing incurable cases, such as we should meet if the symptoms were persistent; and at the same time—as is universally admitted—it is very rarely fatal. Unfortunately the majority of these cases arise from railway injuries, and here we always have the baneful effects of the compensation question. Now it must be admitted that these cases do not recover as rapidly as those to which we have already referred; and we are led to ask why this should be so. Is it because the results of railway collisions are much more severe, or because the expectation of compensation increases the duration of the symptoms? Connected as I have been with two railway companies, I have been struck with two facts, viz.: First, that among the large number of railway officials of every source or grade whom I have known, many of whom have been passengers at the time of collisions, and none of whom could claim compensation, I have never met with any who have suffered from severe or persistent nervous symptoms. And second, that in none of the accidents with which I have been concerned has any railway servant complained of such symptoms. Bruises, fractures, burns, and deaths, we meet with only too frequently, but traumatic hysteria is to me unknown in either of these two classes of persons. As railway officials are constituted like the rest of the population, I presume that they do occasionally suffer from traumatic hysteria, and I can therefore only conclude that they recover from it within a very brief period. We are thus driven to the view that compensation, or, rather, waiting for compensation, markedly aggravates the hysterical symptoms, a position which we can assume without for one moment impugning the honesty of all the sufferers with whom we meet. The origin of traumatic hysteria being an idea or a suggestion, it is but natural that anything which tends to fix this idea will operate toward retarding convalescence. In a compensation case everything does tend to fix the idea. The repeated examinations by various experts, the frequency with which the patient is called upon to detail his every symptom and sensation, the account of his accident which he reads in the press, the almost continuous repetition to himself of his sufferings, all serve but too well to rivet the suggestion on a mind weakened by the worry of legal proceedings and by the fear of the popularly accepted fate of the victim of railway spine. And thus we find that in these 'compensation cases' the prognosis of traumatic hysteria becomes much more grave than in those to which we have referred. In order to give the more accurate prognosis it is necessary to consider certain other conditions which will influence the duration of traumatic hysteria. Thus in the male the symptoms, although less readily produced, appear to be more fixed in character than in the female (Charcot). A neurotic tendency, whether hereditary or acquired, is also of bad omen. Chronic alcoholism again tends to render the prognosis worse. Marked variation in the symptoms, such as transference of hemianæsthesia from one side of the body to the other, or its temporary disappearance, are eminently favorable conditions. In the above remarks, the rare eventuality of death has been ignored. Life is but seldom imperilled by traumatic hysteria, but complications may ensue—which terminate in death."

---

[1] *Loc. cit.*

Dr. Byrom Bramwell's Ideas of Prognosis.[1]

Again, let us quote the ideas of Dr. Byrom Bramwell concerning prognosis in traumatic neurosis. He avers that the future progress and course in cases of this kind are in fact variable. In almost all cases the symptoms persisted and became worse rather than better so long as the anxiety and worry attending litigation were hanging over the head of the patient. This was of course naturally to be expected. After the case was settled some patients got quickly well, but in others recovery was slow. In the great majority of cases recovery, however, ultimately took place. This was more particularly the case where the patient was young and strong. In old, weakly, and debilitated subjects, in those persons who had little or no reserve of nervous energy, the severe shock—to speak popularly—which the nervous system had received, and the prolonged suffering which the patients had gone through, might have so shattered their nerve tone that they never completely regained their former strength and activity. Even in these, the most unpromising cases, a very considerable improvement usually did take place. In judging of the probability of recovery in each particular case, the personal equation had to be taken into account. It was impossible to lay down any general rule which would apply to all cases, as each case had to be judged on its own individual merits.

---

[1] London Lancet, *loc. cit.*

PAGE'S VIEWS ON PROGNOSIS.

We shall not at this juncture apologize for freely quoting Page on this subject, as his views, while well known to all who have studied the subject under consideration, serve to accentuate what has been previously said.

"It remains to be considered to what extent recovery is possible in these cases of nervous shock, and how far the patient regains the mental and bodily vigor which he had before the accident. Happily the record of cases known to me is conclusive upon this point. Recovery is usually complete, and the patient is able to resume his occupation, and to carry on his business as well as he did before. There are, of course, exceptions to the rule, exceptions which show that some alteration has taken place in the bodily physique, and very possibly in the mental vigor also. Thus, you may hear that a man is less likely to bear prolonged fatigue either bodily or mental; that he is more susceptible to the influence of alcohol, more irritable and easily excited; that he lacks that complete self-control which he may formerly have had in his business relations with his fellow-man; that he is nervous when travelling, is afraid to ride or drive, and has been compelled to give up his hunting and shooting; that he is a more nervous man than he was before, and more subject to headaches; and in the severer cases that his hair has turned gray, and he looks prematurely aged. Some years have been added to his life, and he is never quite what he was before. And here very appropriately arises this important question, How far does the course of the protracted illness, apart from the nature of the original injury and shock, conduce to imperfect recovery hereafter? Remember that the symptoms have been largely those of an emotional disturbance; that the loss of control and feebleness of will have been at the foundation of many of them, and there can be no little doubt that an unconscious or wilful yielding to every sensation that may arise; the abandonment of conscious self to the thraldom of the morbid state; the enjoyment, so to speak, of the luxury, not a woe exactly, of gloomy forebodings and feelings and fears, pave the way for the impossibility of regaining, even in the best of circumstances, that complete mental stability and continuous self-control which are the happy appendage of perfect bodily and mental health. A vicious habit is being impressed upon his nervous system, from which the sufferer will find it difficult to rid himself. If he thus allows the various influences conducive to the morbid state to have mastery over him for weeks and months, because he thinks it better to 'wait and see how things turn out,' unable or making no determined effort to resume his natural occupation and mode of living until some wholly impossible compensation has been received, depend upon it he will suffer in the future. Or, worse than this, if he keeps up the morbid state by wilful means, his moral and his physical nature are subjected to a long spread-out shock from which it will be hard to rally. 'As he sows so shall he reap.' "

LANDON CARTER GRAY'S VIEWS OF PROGNOSIS.[1]

Landon Carter Gray says: "There has been much difference of opinion in regard to this very question of prognosis, but I think this difference has arisen mainly from the fact that sufficient regard has not been paid to the peculiar conditions in which patients of this class are usually placed. Few observers will deny, I think, that the symptoms of traumatic neurosis (neurasthenia), especially those due to railway accidents, almost invariably continue for a long time, disabling patients for many years, and in some cases even terminating fatally; but some of the very observers contend that the maintenance of the symptom is due to the psychical condition of the patient, while others insist that it is inherent to the disease. Certain it is that the psychical condition of these patients is a very unfortunate one. However uneducated they may be, newspapers and the talk of every-day life have filled their minds with dread of the mysterious and baleful consequences that may happen to those who receive injuries, particularly in railway accidents. They have also heard for years of the damages, often enormous, which corporations have been obliged to pay. When the accident occurs the nervous system undoubtedly receives a shock, perhaps intensified by the sight of the killed and wounded, with all the attendant horrors, and this shock should receive immediate and judicious treatment by rest, isolation, and medicaments. But instead of this a lawyer or his agent—the so-called 'runner' of this country—quickly appears upon the scene and spurs the patient on to a suit for damages by exaggerating the injury and its consequences, so as to make the too-willing sufferer believe that the company can be readily forced to pay damages. Then come the long years of weary suffering, anxiety, waiting, and disappointment, unrelieved by proper treatment; for, although the patient and the lawyer may not consciously discourage treatment, yet too many hopes and interests would be blasted by a cure to ever permit of treatment being properly carried on, even if any self-respecting physician could be found to undertake it. Months, perhaps a year or more, are passing in waiting for the suit to be tried. I have known of three years having elapsed before this was done, because of delay in obtaining evidence; then in fixing the responsibility upon the right corporation; then by alleged corruption of the attorneys; and finally by the long waiting before the case could be reached upon the calendar of the court. When the suit has been brought and pushed to successful termination, an appeal to a higher court will usually be taken, perhaps to a second higher court, and thus months or years more pass by. In some cases it may even happen that a successful issue in court of highest resort is contested upon a charge of conspiracy, or some matter of legal technicality that is concocted in order to gain time. Finally, the case being at last successfully ended, it may turn out, much more frequently than is dreamed of by those who have not had a long experience, that the costs of the action and the lawyers' fees will leave but a pitiful sum of money at the disposal of the patient.

---

[1] *Loc. cit.*

"This is not an exaggerated picture by any means; it is a composite portrait of dozens of cases whose details can be taken from my case-books. All this disturbance that follows the accident is oftentimes, I am firmly convinced, a more potent cause of the neurasthenia than the accident itself; and I feel sure that it is the secondary psychical disturbance that makes this form of neurasthenia more intractable than other forms of neurasthenia; although I cannot quite agree with the statement which I have often heard made on the witness-stand by very competent colleagues, that traumatic neurasthenia does not differ from other forms of neurasthenia except in the psychical element. Notwithstanding that Charcot does not exactly say this, it is yet evident that he takes very much the same view in regard to the hysterical origin of these cases. Not only, however, are their symptoms to a certain extent pathognomonic, but there never yet has been any clinical proof adduced to demonstrate that the differences between this and other neurasthenic types is due alone to the mental elements. Nevertheless I firmly believe that it is the psychical element together with the resulting lack of proper treatment that makes the usual unfavorable prognosis of this class of cases.

"In several instances I have persuaded patients to promptly place themselves under treatment, and at the same time either to abandon or compromise the legal proceedings; and in every instance a cure has been effected. I have a history of fifteen such cases. In other words, in order to make my meaning perfectly plain, in a matter of this importance, let me repeat by stating that while I do not believe that traumatic neurasthenia is a species of disease that has distinctive features of its own, I do not believe that it has an unfavorable prognosis, provided that the psychical element can be excluded and prompt and proper treatment can be undertaken. It must be clearly borne in mind, however, that this statement applies only to this group of functional symptoms, and that it does not apply to organic diseases caused by injury. But moral responsibility cannot be hereby avoided by the persons or corporations by whom the injury has been caused; for whether the neurasthenia is rendered more intractable or not by the accompanying psychical element, the injury itself has been the cause of all the symptoms. Whether the legal responsibility of these individuals or corporations is lessened on this account, is a question of law for the courts to determine, and we physicians have nothing whatever to do with that aspect of the question."

DERCUM'S AND DANA'S VIEWS OF PROGNOSIS.[1]

Dercum says: "My experience does not accord with that of those who claim that the symptoms in a given case disappear with the award of damages. That buoyancy and exaltation sometimes follow a successful issue of the trial, and that these symptoms of mental depression, so frequently present, disappear for a time, at least, cannot be denied. However, if the case be watched it will be found that long after the trial with its excitement has passed away, the ordinary symptoms of the case persist."

Dana, referring to Page, says: "His views are rather too hopeful, and decidedly are not always borne out by his own notes. 'Patient improving at last accounts,' is a formula given, but it may mean very little after all. Traumatic neurasthenia, or railway hysteria, is generally recovered from in a great measure. In my experience traumatic neurasthenia is the most amenable to treatment. But it is very often the case that the man who has had a severe nervous shock is never entirely the same man he was before. This is particularly the case if he has reached middle life, or is of a neuropathic constitution. The very old and the very young seem to suffer less." His conclusions are that the prognosis of railway or traumatic neurasthenia and hysteria is very good so far as steady improvement is concerned, not so good as regards complete recovery.

PUTNAM'S, KNAPP'S, AND BREMER'S VIEWS OF PROGNOSIS.[2]

Putnam says: "The question often arises in court, Does the fact that the symptoms complained of have endured a long time previous to the trial, warrant the conclusion that they will pass away but slowly if at all? It is probable that this question may be answered in the negative, so far as the localized functional disorders are concerned. Such symptoms may last indefinitely, so long as the influences are unfavorable to a cure—

---

[1] Dercum: Alienist and Neurologist, *loc. cit.* Dana: New York Medical Record, *loc. cit.*

[2] Putnam: Am. Jour. Neurology and Psychiatry, *loc. cit.* Knapp: Boston Med. and Sur. Jour., *loc. cit.* Bremer. Alienist and Neurologist, *loc. cit.*

such as the prospects of a trial—yet in the end pass away very rapidly. Perhaps this is less often true, however, of cases of the neurasthenic type."

Knapp says: "Prognosis of these conditions is grave. Improvement is not uncommon, but complete recovery is rare."

Bremer, in the consideration of this subject, says: "The excitement incident to litigation renders these cases progressively worse, and many a claimant would have fared much better in health and happiness had he settled at a reasonable figure, instead of undergoing the harassing wear and tear of a lawsuit. Not the most liberal reward will repay such a man for the often deep and lasting damage his brain has sustained from prolonged litigation. On the other hand it is often astonishing what amount of elasticity and recuperative power is exhibited by the successful claimant. Nowhere has the gold cure celebrated greater triumphs than in the field of traumatic neurosis, if administered by a benevolent jury. There dwells a familiar figure in the memory of those who frequently have to deal with these cases, of the neurotic cripple who has to be assisted to ascend the witness-stand and gives his testimony in a feeble and broken voice, an utter, pitiable wreck, physically and mental; and who a few weeks later is capable of carrying the weight of several thousand dollars in silver, the award of damages, without any apparent difficulty. Again cases are on record where successful litigants openly bragged, after having secured their booty, how they duped the doctors, judge, and jury."

Clevenger, in his book on "Spinal Concussion," says: "As to prognosis (in traumatic neurosis) it is apparent that every case will have to be considered by itself. From the revision of the entire subject, it is seen that the old classifications and description included and omitted too much. Heavy and light blows may either of them cause slight or grave symptoms, and in time either of these may end in recovery or death."

CONTINENTAL WRITERS' VIEWS OF PROGNOSIS.

We have thus far given the opinions of English and American authors, and it will be found there is a considerable degree of uniformity, particularly when due consideration is given to the positive influences of adverse conditions. Many of the apparent differences of prognosis expressed in these two countries can be reconciled, but the differences between these and the views of observers are too great to be explained upon any other basis than that of a racial difference.

Oppenheim says: "As regards life the prognosis is favorable, except when nervous heart disturbances proceed to organic affections. A danger to life exists in an inclination to suicide through mind derangement, but this is seldom realized. Complete recovery seldom takes place in our observation. Even Page admits this; for in most of his cases he notes a diseased irritability remaining which marks the person as a 'damaged man.' At all times these cases are liable to develop a severe and hallucinatory bewilderment or insanity—a transformation which we have several times had an opportunity to witness. Of dubious prognosis are cases in which epilepsy or dementia is included in the symptoms, as well as where decided cardiac troubles are present. Not uncommonly a special *régime* produces a betterment in some cases; but it is especially observable that those who are involved in legal proceedings are retarded in their recovery, and this is a complication to be considered. Often the interest in an expected verdict causes the patient not to desire recovery until his suit is decided. The patient thinks it is to his interest to exaggerate the subjective difficulties and to simulate. The law proceedings weigh heavily upon the individual, and affect him more because he is mentally altered. So we often see improvement in symptoms after a favorable issue. But in my experience the greater number have, after the termination of a legal quarrel, remained unchanged in their ailments by the event."

Singer[1] states that of twenty-nine cases, three were cured; seven were completely capable of work; eleven partly recovered; and the rest were not improved.

Eisenholz and Schultze do not regard the prognosis as uniformly as bad as do other authorities. Freund refrains from taking the same dismal view as many other authorities. Dubois of France believes that cure is rare.

Guillemand in the consideration of prognosis classifies his cases under seven headings: (commencing with the second) hysterical accidents, neurasthenic accidents, hystero-neurasthenic accidents, hystero-traumatic accidents, traumatic-neurasthenic accidents, hystero-neurasthenic-traumatic accidents. He states that of all the neurotic states to which traumatism gives rise, hystero-traumatism compromises health the least, but he avers that at times it presents a tenacity which is despairing. Though presenting complications consisting of contractures and paralysis of long duration, the disease may disappear as suddenly as it came. Traumatic neurasthenia and traumatic hystero-neurasthenia, while the life of the patient is not absolutely menaced, are very troublesome. The affection may remain stationary, or recede, but the patient will never return to this former soundness. This is especially the case following railway accident.

---

[1] *Loc. cit.*

M. Vibert states that prognosis is bad. M. Bouveret says in general that life is not compromised, and its duration is not diminished on account of the neurosis itself. Yet some patients have ideas of suicide to which they finally succumb.

It will be seen from the authors thus far quoted that extreme differences are particularly marked; hence nothing that we can say will present the subject in a better light than what Gray has said regarding the differences between hysteria as seen in this country and as described by Charcot in France: "It is possible, however, that too little account has been taken of the inherent differences that there are between the Latin and the Anglo-Saxon races, and the race that is growing up in this country from a larger fusion of different nationalities than has ever taken place before in the recorded history of the world."

It is but natural to assume where we have multiblended inherited elements, that fixed types of disease are not likely to occur; certainly they are less likely to occur than where the opposite condition exists. We believe that the hysterical element is plainly natural to France; and we believe that the neurasthenic element is well pronounced and definite in Germany; but we are not as likely to find in this country any uniformity regarding the production of hysterical and neurasthenic conditions. Again we believe that too little account has been taken of the influence of just compromise. In this matter, accumulated experience will show that when all of the effects arising from the worry which is incidental to litigation are eliminated the prognosis is favorable; that unfavorable surroundings only confirm and intensify the original injury, and make prognosis unfavorable. It is constantly manifest that where rest, isolation, and the proper surroundings have been used, uniformly good results have been obtained. Hence if the full measure and force of compromise relieves all these elements of worry, waiting, and irritation, it certainly would seem that it should be used whenever and wherever possible. For many years we have seen the full force and beneficial element of compromise; and we cannot but think that in cases which assume a grave form, there has invariably been faulty treatment, environment, and circumstances to which the deplorable condition was more due than to the original injury.

BIBLIOGRAPHY.

Adams, C. F., Jr.: "Notes on Railway Accidents." New York, 1897.

Addresses delivered before the World's Railway Commerce Congress under the auspices of the World's Columbian Auxiliary Exposition, 1893.

Alt, A.: "Lectures on Human Eye." St. Louis, Mo., 1887.

"American Railway, its Construction, Development, Management, and Appliances." Edited by Thomas M. Cooley. New York, 1893.

"An American Text-Book on Surgery for Practitioners and Students." Edited by W. W. Keene and J. William White. Philadelphia, 1892.

Bailey, Pearce A.: "A Text-Book of Legal Medicine and Toxicology." Edited by Frederick Peterson and Walter S. Harris. Philadelphia and London, 1903.

Bailey, Pearce A.: "Accidents and Injuries." New York, 1898.

Bergman E. von: "A System of Practical Surgery." New York and Philadelphia, 1904.

Booth, J. A.: "Traumatic Neurosis," in Annual of the Universal Medical Sciences, Philadelphia, 1892, 1893.

Bowlby, Anthony A.: "Injuries and Diseases of Nerves." Philadelphia, 1890.

Bramwell, B.: "On Concussion of the Spine with Special Reference to Railway Accidents and Injuries," London Lancet, August 12, 1893.

Bremer, L.: On "Traumatic Neurosis in Court," Medical Review, St. Louis, 1893.

Bryant, T.: "A Manual for the Practice of Surgery." Philadelphia, 1889.

Bryant, T., F.R.C.S.: "A Manual for the Practice of Surgery." Philadelphia, 1885.

Charcot, J. M.: "Lectures on Diseases of the Nervous System." Philadelphia, 1879.

Charcot, J. M.: "Lectures on the Pathological Anatomy of the Nervous System." Cincinnati, 1881.

Church and Peterson: "Nervous and Mental Diseases." Philadelphia, 1900.

Clarke, J. Michael, M.D.: "Hysteria and Neurasthenia." London and New York, 1905.

Clevenger, S. V.: "Legal Aspect of Spinal Concussion," Journal of American Medical Association, November 1, 1890.

Clevenger, S. V.: "Spinal Concussion." Philadelphia, 1889.

DaCosta, J. C.: " Manual of Modern Surgery." Philadelphia, 1898.

Dana, Charles A.: "The Traumatic Neuroses" in a " System of Legal Medicine," Vol. II., by Dr. Allan McLane Hamilton and others, 1900.

Dana, Charles A.: "The Partial Passing of Neurasthenia," Boston Medical and Surgical Journal, March 31, 1904.

Defendorf, A. Ross: " Clinical Psychiatry." New York, 1902.

Dercum, F. X.: In "A Text-Book on Nervous Diseases," by American Authors, Philadelphia, 1895.

Dercum, F. X.: "The Prognosis of Railway Spine," The Alienist and Neurologist, St. Louis, October, 1893.

Draper, W. F.: Annual of the Universal Medical Sciences, Philadelphia, 1889, 1890, 1891, 1892.

Elwell, J. J.: "A Medico-Legal Treatise on Malpractice," etc. New York, 1881.

Erichsen, J. E.: "On Railway and Other Injuries." Philadelphia, 1867.

Ewald, C. A.: "The Diseases of the Stomach." New York, 1892.

Farquharson, R.: "Feigned Diseases," in Quain's "Dictionary of Medicine." New York, 1883.

Foster, Frank P.: Illustrated Encyclopædic Medical Dictionary. New York, 1893.

Golebiewski, Dr. Ed.: "Atlas and Epitome of Diseases Caused by Accidents." Philadelphia, 1900.

Gowers, R. W.: "A Manual of Diseases of the Nervous System."

Graser, Dr. E.: In "A System of Practical Surgery," by Bergmann, P. von Bruns, and J. von Mikulics. New York and Philadelphia, 1904.

Gray, L. C.: "A Treatise on Mental and Nervous Diseases." Philadelphia, 1893.

Guillemand, C.: "Railroad Accidents and their Medico-Legal Consequences." Paris, 1891.

Hamilton, Allan McLane: "Railway and Other Accidents." New York, 1904.

Hammond, W. A.: "A Treatise on the Diseases of the Nervous System." New York, 1892.

Hare, Hobart Amory: "Practice of Medicine." Philadelphia and New York, 1905.

Harrison, R.: "Lectures on Surgical Disorders of the Urinary Organs.' London, 1887.

Henle, Prof. A.: In Vol. II. of Bergmann's "System of Surgery.

Hirt, L.: "Diseases of the Nervous System." New York, 1893.

Hoffman, Dr. E. von: "Atlas of Legal Medicine." Philadelphia, 1898.

Jaksch, R. v.: "Clinical Diagnosis, the Bacteriological, Chemical, and Microscopical Elements of Disease." London, 1890.

Janet, Pierre L., H.D., M.D.: "The Mental State of Hystericals." New York, 1901.

Judd, H.: "Spinal Injuries from Railroad Accidents," Journal of the American Medical Association, Chicago, February 23, 1889, and January 12, 1889.

Knapp, P. C.: "Concussion of the Spine," Boston Medical and Surgical Journal, November 1, 1888.

Knapp, P. C.: In "A Text-Book on Nervous Diseases by America Authors." Philadelphia, 1895.

Kraepelin, Dr. Emil: "Clinical Psychiatry." New York, 1904.

Lidell: Holmes' "System of Surgery."

Macewen, William: "Pyogenic Infective Diseases of the Brain and Spinal Cord." New York, 1893.

Merwin, H. C.: On "Malpractice" in "Reference Handbook of the Medical Sciences," Vol. IV. New York, 1889.

Moullin, C. W. M.: "Surgery, a Practical Treatise, with Special Reference to Treatment." Philadelphia, 1891.

Moyer, H. N.: "A Consideration of the Traumatic Neurosis, So-called," The Alienist and Neurologist, St. Louis, October, 1893.

Nicholls, W. J.: "The Railway Builder." Philadelphia, 1883.

Oppenheim, H.: "The Traumatic Neurosis." Berlin, 1889.

Oppenheim, H.: On "Simulation in Traumatic Neurosis." Berlin, 1891.

Osler, W.: "The Principles and Practice of Medicine." New York, 1892.

Page, H. W.: "Railway Injuries in their Medico-Legal and Clinical Aspects." London, 1891.

Park, Roswell: "A Treatise on Surgery." Philadelphia, 1896.

Regis, Dr. E.: "A Practical Manual of Mental Medicine." Philadelphia, 1898.

Seguin, E. C.: "Traumatic Neurosis," in Annual of the Universal Medical Sciences, 1889, 1890, 1891.

Smith, H. H.: "Concussion of the Spine in its Medico-Legal Aspect," Journal of the American Medical Association, August 10, 1889.

Stretton, C. E.: "Safe Railway Working." London, 1893.

Thorburn, W.: "A Contribution to the Study of the Spinal Cord." Philadelphia.

Treves, F.: "A Manual of Surgery, treated by various authors." Vol. II. Transactions of Missouri State Medical Association, 1888.

Voss W.: "Railway Car Constructions." New York, 1892.

INDEX.

PAGE
Abdomen, contusions of, 127
wounds of, 126
Abdominal viscera, rupture of, 128
wounds of, 128
wall, contusions of, 126, 127
wounds of, 126
Abortifacients, drugs used as, 372
Abortion, 355, 357, 369
and hypnotism, 385
cases illustrative of, 401
criminal, 355, 369
duties of medical experts in cases of, 394
diagnosis of, 357
examination of discharged matters, 359
clots, 396, 399
drugs, instruments, etc., 397, 399
fœtus, 396, 399
ovum, 396, 399
woman during life, 358, 394, 398
after death, 396, 398
hemorrhage after, 386
ill effects of, 387
induced, 357
injuries produced by, 389
measures used to produce, 371
general methods, 380
internal remedies, 372
local measures, 381
natural, 364
causes of, 364
fœtal causes, 367
habit of, 365
maternal causes, 366
self-induced, case of, 359
sepsis after, 386

ABORTION, PAGE
    sequelæ of, . 386
        hemorrhage, . 386
        sepsis, . 386
        subinvolution, . 387
        tetanus, . 393
    signs of, . 395
    size of embryo, . 361
    spontaneous, . 357, 364
    subinvolution after, . 387
    tetanus after, . 393
    was it caused by a given drug? . 379
    was it spontaneous or induced? . 364
    was its induction justifiable? . 368
    weight of fœtus, . 363
ABSCESS OF BRAIN, . 109
ADOPTION, sexual incapacity and, . 634
AGE OF CONSENT, . 660, 664
AGENESIA, . 628, 739
ALCOHOLISM, . 110
AMOR LESBICUS, . 731
ANAPHRODISIA, . 628, 642
ANIMALS, sexual criminality in, . 743
    unnatural relations with, . 744
APNŒA, . 225, 318
ARTERIES, wounds of, . 124
ASPHYXIA, . 225
    by submersion, . 318, 319
    external appearances due to, . 231
    internal appearances due to, . 235
    survivorship in cases of death by, . 346
ASSAULT, INDECENT, . 662, 664, 706
ATAVISM, . 645
AUTOHYPNOSIS, . 775
AUTOPSIES, after death from electricity, . 218
AZOOPHILIA, . 739

BACK, injuries to, . 816, 818, 819, 820, 823
BALLOTTÉMENT, . 565
BASTARDY, impotence and, . 634
BESTIALITY, . 737, 743, 744
    examination in alleged cases of, . 758
BIRTHS, see Labor
    coffin, . 613
    post-mortem, . 366, 613
    precocious, . 521

PAGE

- BIUTERINE MARRIAGES, 755
- BLADDER, rupture of, 131
  - wounds of, 131
- BLANK CHARGES, wounds by, 166
- BLOOD, coagulation of, 34, 218
    - after electrical injuries, 218
  - extravasation of, in brain, 111
  - on weapons, 81
- BLOWS ON ABDOMEN CAUSING DEATH, 17
- BODY, examination of, 83
- BRAIN, abscess of, 109
  - compression of, 847
  - concussion of, 107, 843
  - congestion of, in drowning, 318
  - extravasation of blood in, 111
  - wounds of, 115
- BREASTS, see Mammæ
- BUCCAL COITUS, 750
- BULLETS, 141
  - experiments with, 169
  - infected, wounds by, 169
  - loss of weight of, 147
  - track of, 141
- BURKING, 297
- BURNS, by electrical currents, 180, 192
  - lightning, 211

- CADAVERIC CHANGES, see Post-mortem
- CASES illustrative of:—
  - abortion, 401
    - self-induced, 359
  - coffin-birth, 614, 616
  - corpora lutea, 595
  - diagnosis of delivery, 595
    - of pregnancy, 576
  - early viability, 541
  - feigned labor, 580
    - lying-in-state, 580
    - pregnancy, 580
  - hanging, 282
    - accidental, 296
    - homicidal, 289
    - judicial, 292
    - suicidal, 282
  - infanticide, 478

Cases illustrative of:— PAGE

- mother's marks, 544
- post-mortem parturition, 614, 616
- prolonged pregnancy, 515
- resemblances between parent and child, 544
- strangulation, 243
  - accidental, 251
  - homicidal, 243
  - suicidal, 249
- substitution of children, 551
- suffocation, 309
  - accidental, 309
  - homicidal, 312
  - suicidal, 312
- superfœtation, 600
- unconscious delivery, 610
  - impregnation, 604
  - pregnancy, 606

Cause of death:—

- from severe mechanical injury, 45
- from submersion, 319
- from wounds, 42, 43, 55
- hemorrhage as, 43
- latent disease as, 49
- shock as, 45
- was it natural? 49
- wounds as secondary, 55

Chancroid, 687

Child (see Infant, Fœtus), 355

Clitoridism, 755

Clothing, action of lightning on, 209

- examination of, 25, 83

Coagulation of blood, in death from electricity, 218

- in wounds, 34

Coffin birth, 613

- case of, 614, 616

Coitus, buccal, 750

- rectal (see Pederasty), 749

Cold, survivorship in cases of death by, 347

Coma, 225

Commotio cerebri, 843

Compression of brain, 847

Concussion, 18

- of brain, 107
- of spinal cord, 119, 825
- of spine, 870

PAGE

- CONSENT, age of, 660, 664
- CONTRACTURES, 910
- CONTRE-COUP, 105, 159
- CONTUSIONS, 13, 16, 69
  - by lightning, 212
  - of abdomen, 126, 127
  - of head, 104
  - of neck, 116
- CORPORA LUTEA, 592
  - cases of, 595
- CRIMES, unnatural, 737
- CRUSHES, by fall of heavy weights, 99, 100

- DEAD BODY, examination of, for evidence of gunshot wounds, 158
- DEAD-BORN, 416
- DEATH, following rape, 677, 690
  - from abdominal blows, 17, 45
  - from anæsthetics, 62
  - from blows on the head, 18
  - from electrical currents, 200
  - from hanging, proof of, 279
  - from latent disease, 49
  - from natural causes, 49
  - from slight injuries, 53
  - from strangulation, proof of, 238
  - from submersion, 317, 319
  - from suffocation, 299, 458
    - proof of, 306
  - from surgical operations, 61, 173
  - from wounds, causes of, 42, 43, 55
- DEATHS IN A COMMON DISASTER, 337
  - expert medical testimony in, 340
- DEFLORATION,
  - complete, recent, 676
  - diseased conditions simulating, 680
  - errors in examination, 701
  - genitals after, 676
  - hemorrhage from, 676, 678
  - in children, 708
  - incomplete, 710
    - recent, 679
  - lacerations of hymen in, 677, 708
  - non-recent, 679
  - rules for examination, 701
  - signs of, 674

DEFLORATION, PAGE
- simulated, ... 701
- slight signs of, in prostitutes, ... 680

DELIRIUM TREMENS, ... 60, 173

DELIVERY,
- date of, ... 590
- diagnosis of, cases illustrative of, ... 595
  - in the dead, ... 590
  - in the living, ... 586
- feigned, ... 579
- how long after can diagnosis be made? 590
- how soon after can woman become pregnant? 600
- post-mortem, ... 613
- signs of recent, ... 585
  - in the dead, ... 590
  - in the living, ... 586
  - positive, ... 589
  - probable, ... 587
  - uncertain, ... 586
- unconscious, ... 608
  - cases illustrative of, ... 610

DIAMETERS OF THE FŒTAL HEAD, ... 531

DIAPHRAGM, rupture of, ... 125
- wounds of, ... 125

DISLOCATION FRACTURE, of the spine, ... 830, 831

DISLOCATIONS, ... 22

DROWNING, see Submersion, ... 317

ECCHYMOSES, ... 13
- caused by lightning, ... 212
- post-mortem, ... 31

ELECTRIC CARS, ... 184

ELECTRIC DRILL, effect of, upon the eyes, ... 193

ELECTRIC LIGHT, effects of, upon the eyes, ... 192

ELECTRICAL APPARATUS, injuries from, ... 180

ELECTRICAL CURRENTS, burns from, ... 180, 192
- death from, ... 200
- direct injuries from, ... 187
- direct symptoms of injury from, ... 192
- fatal, ... 199
- high-tension, ... 182
- indirect injuries from, ... 186
- injury from, ... 180
- internal symptoms caused by, ... 195
- mechanical effects of, ... 191
- mental symptoms from, ... 206

PAGE

Electrical currents,
  muscular contraction from, 191
  resistance of human body to, 189
  treatment of injuries from, 220
Electrical resistance, 189
Electricity, 179
  autopsies after death from, 218
  faradic, 188
  medical, 180
  static, 189
  survivorship in cases of death from, 348
Electrocution, 200
  post-mortem findings after, 219
Embryo, see Fœtus
  characters of, during several months of pregnancy, 361, 535
  signs of maturity of, 362
  size of, 361
  weight of, 363
Erosion, 17
Erysipelas, 57
  facial, 58
Examination of body, 83, 84
  clothes, 25, 83, 84
  surroundings, 87
Excoriation, 17
Exhaustion, death due to, 46
Exhibitionism, 742
Experiments, testing powder-marks, 161
  with cadavers, 152, 153
Expert testimony, in cases of death in a common disaster, 340
Experts, medical, duties of, in cases of criminal abortion, 394
  why employed, 921
Exposure, indecent, 742
Extremities, wounds of, 135
Eyes, injurious effect of electric light upon, 192
  injurious effect of electric drill upon, 193

Face, wounds of, 115
Falls, 95, 98
Faradism, 188
Fellation, 750
Fetichism, 739
Firearms, evidence from, 146
  examination of, 159
Flash of gunpowder, identification by, 167
Fœticide, 355

PAGE
Fœtus (see Embryo, Infant), ... 355
  can it live after death of mother? 623
  characteristics of, during several months of pregnancy, . . 361, 535
  death of, from congenital malformation, ... 448
    from debility, ... 448
    from disease, ... 449
    from hemorrhage, ... 449
    from injuries to the head, ... 464
    from natural causes, ... 446
    from prolapse of the cord, ... 454
    from protracted labor, ... 447
    from violent causes, ... 456
  fully developed, ... 540
    weight of, ... 540
  heart sounds of, in pregnancy, ... 573
  how long can it live after death of mother? 453
  movements of, in pregnancy, ... 574
  natural causes of death of, ... 446
  palpation of, in pregnancy, ... 572
  signs of maturity of, ... 362
  size of, ... 361
  specific gravity of lungs of, ... 427
  time when life begins in, ... 355
  violent causes of death of, ... 456
  weight of, ... 363
    of lungs of, ... 426
      in relation to weight of body, ... 427
Fractures, ... 20, 37, 99
  by gunshot wounds, ... 158
  of ribs, ... 120
  of skull, ... 105
    during labor, ... 467
  of spine, ... 117
  of sternum, ... 120
  of vertebræ 830
  spontaneous, ... 21
  subcutaneous, due to gunshot wounds, ... 144
  whether ante-mortem or post-mortem, ... 37
Fracture-dislocation of spine, ... 117
Fragilitas ossium, ... 20
Frigidity, ... 628

Gall bladder, wounds and ruptures of, ... 130
Garroting, ... 117, 223
Genital abuse, ... 740

PAGE

GENITAL ORGANS, wounds of, ... 134
GENITALS, female, see Hymen, Uterus, Vagina, Vulva
  after defloration, ... 676
  changes in, during pregnancy, ... 558
  in virgins, ... 666
  of children after rape, ... 708, 721
GESTATION, see Labor, Pregnancy
GLASS, wounds caused by, ... 68
GONOCOCCUS, ... 685
GONORRHŒA, ... 683, 705, 713, 729
GREEK LOVE, ... 739
GUNSHOT WOUNDS (and see Wounds, gunshot), ... 139

HÆMATOMATA, ... 14
HÆMATOMYELIA, TRAUMATIC, ... 840
HÆMATORRHACHIS, ... 839
HAIRS, ... 758
  on weapons, ... 81
HANGING, ... 223, 252
  accidental, ... 282
    cases illustrative of, ... 296
  cases illustrative of 282
  cause of death in, ... 253
  homicidal, ... 281
    cases illustrative of, ... 289
  incomplete, ... 261
    external appearances due to, ... 264
    internal appearances due to, ... 273
  judicial, cases illustrative of, ... 292
  post-mortem appearances, ... 264
    external, ... 264
    internal, ... 273
  proof of death by, ... 279
  suicidal, ... 280
    cases illustrative of, ... 282
  symptoms in, ... 258
  treatment in, ... 262
HEAD, wounds of, ... 103
HEART, in strangulation, ... 235
  rupture of, ... 124
  wounds of, ... 121
HEAT, survivorship in cases of death by, ... 347
HEMORRHAGE, ... 29, 43, 232
  death from, ... 43, 44
  from ante-mortem wound, ... 29

HEMORRHAGE, PAGE
- from post-mortem wound, ... 30
- internal, death from, ... 43

HERMAPHRODITES, ... 636

HERNIA, phrenic or diaphragmatic, ... 126

HETEROPHEMY, ... 775

HOMOSEXUALITY, ... 739

HYMEN, ... 669
- as sign of virginity, ... 666, 672, 676
- destruction of, by accident, surgical operations, etc., ... 675
- does absence of integrity of, indicate defloration? 674
- form of, ... 701
  - in children, ... 707
- is an intact hymen evidence of virginity? 672
- lacerations of, ... 677
  - in children, after rape, ... 708
- of children, after rape, ... 708, 723
- penetration of, ... 673
- rupture of, by masturbation, ... 675, 734
- varieties of, ... 669

HYPNOTIC STATE, impregnation during, ... 603
- rape during, ... 696

HYPNOTISM, and abortion, ... 385

HYPOSTASES, ... 232

HYSTERIA, ... 902, 912

IDENTIFICATION, by flash of gunpowder, ... 167
- in death from submersion, ... 324

ILLUSTRATIVE CASES, see Cases

IMPOTENCE, ... 627, 739
- accidental, ... 633
- and bastardy, ... 634
- causes of, ... 644
- from wounds and injuries, ... 639
- in accusations of rape, ... 703
- in advanced age, ... 641
- in man, ... 652
- in suits for civil damage, ... 639
- in woman, ... 648
- influencing conditions from accident or disease, ... 653
- of castrates, ... 653
- plea of, in accusations of unchaste conduct, ... 640

IMPREGNATION, ... 508, 511
- artificial, ethical considerations of, ... 629
- during hypnotic state, ... 603
- former, effects of, upon fœtus, ... 543

PAGE

- IMPREGNATION,
  - relation of, to menstruation, 508
  - unconscious, 602
    - cases illustrative of, 604
- IMPRINTS, 88
- INCAPACITY, SEXUAL, see Sexual Incapacity
- INCISED WOUNDS, see Wounds, incised
- INDECENT EXPOSURE, 742
- INFANT (and see Fœtus, Infanticide), 355
  - born before term, viability of, 522, 523
  - can it live after death of mother? 453
  - death of, from cold or exposure, 463
    - from drowning, 462
    - from hanging, 474
    - from injuries to the head, 464
    - from neglect, 457
    - from omission, 457
    - from poisoning, 474
    - from starvation, 463
    - from strangulation, 472
    - from suffocation, 458
    - from violent causes, 456
    - from wounds, 463
  - deformities of, 543
  - effect of former impregnations upon, 543
  - mature, characteristics of, 528, 534
    - diameters of head and body, 531
    - length of, 528
    - ossification of lower epiphysis of femur, 533, 540
    - weight of, 529
  - rape upon, 705
  - resemblances of (and see Mother's marks, Atavism), 542
  - substitution of, 547
    - cases illustrative of, 551
  - supposititious, 547
    - cases illustrative of, 551
  - viability of, 421, 520, 522, 523
- INFANTICIDE (and see Infant, Fœtus), 355, 408
  - cases illustrative of, 478
  - concealment of birth, 409
  - dead-birth, see Live-birth, Still-Birth
  - death of mother during delivery, 453
  - evidence from autopsy, 422
    - from changes in the chest, 422
      - in the cord, 450
      - in the diaphragm, 422

Infanticide, evidence from changes, PAGE
in the lungs, ... 422
from marks of violence, ... 422
examination of woman, ... 412
how long did child live? 443
live-birth (and see Still-birth), ... 409, 416, 520, 526
Breslau's test of, ... 438
evidence of, ... 410
from bladder and kidneys, ... 437
from breathing, ... 415
from changes in cord, ... 436
in liver, ... 437
in skin, ... 437
in stomach and intestines, ... 438
from crying, ... 414
from fœtal heart-beat, ... 413
from lungs, ... 422
from muscular movements, ... 414
from pulsation of cord, ... 413
Foderé's test of, ... 426
hydrostatic test of, ... 427
objections to, ... 428
iron-lung test of, ... 442
legally considered, ... 410
middle-ear test of, ... 437
Ploucquet's test of, ... 427
respiration as evidence of, ... 419
Schmidt's test of, ... 426
signs of, ... 410
specific-gravity test of, ... 427
static test of, ... 426
what constitutes? 526
Zaleski's test of, ... 442
method of conducting autopsy, ... 474
rupture of cord, ... 450
still-birth, ... 416
evidence of, from bacteria, ... 442
from maceration, ... 416
from mummification, ... 419
from putrefaction, ... 416, 418
was death due to natural causes or to violence? 446
was the child born alive? 409
was the cord torn or cut? 452
Infected bullets, ... 169
powder, ... 170
Injuries, coagulation of blood in, ... 34

Injuries, PAGE
- death from, 45, 46
- fatal, acts performed after, 39
- multiple, death from, 46
- of abdominal walls, 126
  - viscera, 126
- of spinal cord, 117
- of spine, 117
- severe, death from, 45
- slight, death from, 53
- whether ante-mortem or post-mortem, 28

Insulation of electrical conductors, 183

Intestines, wounds of, 132

Irrumation, 750

Kidneys, rupture of, 130
- wounds of, 130

Killing of unborn child, 411

Labor, 507
- disputed, 553
- feigned, 579
  - cases illustrative of, 580
- protracted, cause of fœtal death, 447

Lanugo, 531

Larynx, in death from hanging, 274
- from strangulation, 237

Legitimacy, 514, 520, 523

Lesbianism, 731

Leucorrhœa, 683, 711

Life (and see Viability, Infanticide, Live-birth), 421

Lightning, 207
- action of, on clothing, 209
- autopsies after death from, 218
- burns from, 211
- contusions by, 212
- convulsions from, 215
- disturbances of sensation from, 215
- effects on internal organs, 219
- hearing affected by 216
- loss of consciousness from, 213
- loss of memory from, 221
- mental impairment from, 214
- paralysis from, 214
- pathology of stroke of, 217
- post-mortem findings, 220

LIGHTNING, PAGE
- sight affected by 216
- smell affected by, ... 217
- staining of skin by, ... 213
- survivorship in cases of death by, ... 348
- symptoms produced by, ... 210, 213, 217
- taste affected by, ... 217
- treatment of injuries from, ... 220
- wounds by 212

LITIGATION PSYCHOSIS, ... 871

LIVE-BIRTH, ... 409, 416, 520, 526

LIVE-BORN, ... 416

LIVER, rupture of, ... 128
- wounds of, ... 128

LIVING PERSON, examination of, ... 497
- as to age, in civil cases, ... 502
- as to insanity, in civil cases, ... 502
  - in criminal cases, ... 499
- examination of plaintiff in civil actions to recover damages for personal injuries, ... 502
- in cases of alleged impotency in actions for divorce, . . . 501
- in cases of infancy, in criminal cases, ... 497
- in civil cases, ... 501
- in criminal cases, ... 497
- in disputed heirship, ... 501
- refusal of plaintiff to submit to medical examination, when admissible in evidence, ... 504
- to determine age, ... 497
- to determine existence of pregnancy in capital cases, . . . 499
- when defendent in a criminal action pleads insanity, . . . 499

LUMBAGO, TRAUMATIC, ... 818, 821

LUNGS, in death from strangulation, ... 236
  - from submersion 327
- wounds of, ... 121

LUST MURDER, ... 677, 691

LYING-IN STATE, feigned, cases of, ... 580

LYMPHORRHAGIA, ... 16

MALINGERING, ... 952

MAMMÆ, changes of, in pregnancy, ... 568
- in virgins, ... 675

MARRIAGE, sexual incapacity and dissolution of, ... 635

MARKS OF POWDER, ... 155, 160

MASK OF PREGNANCY, ... 556

MASSOCHISM, ... 739

MECONIUM, ... 440, 532

PAGE

MENOPAUSE, ... 649
MENSTRUATION, age at which begins and ends, ... 649
  cessation of, in pregnancy, ... 557
  relation of, to impregnation, ... 508
    to ovulation, ... 510
MONSTERS, ... 448
MORNING SICKNESS, ... 554
MOTHER'S MARKS, ... 542
  cases illustrative of, ... 544
MUSCULAR CONTRACTION, from electrical current, ... 194

NECK, contusions of, ... 116
  wounds of, ... 115
NECROPHILIA, ... 731, 761
NEWBORN, ... 356
NOXIOUS THING, ... 370
NUBILITY, ... 645
NYMPHOMANIA, ... 739

OBSCENE PUBLICATIONS, prohibition of, ... 740
OVERLAYING, ... 296
OVULATION, relation of, to menstruation, ... 510
OVUM, when liberated from ovary, ... 510

PARTURITION, survivorship in death during, ... 348, 454
PEDERASTY, ... 737, 740
  examination of persons accused of, ... 759
  practices and manifestations of, ... 748
PITHING, ... 118
POISONING, ... 143
  survivorship in cases of death by, ... 348
POSITION OF VICTIM, ... 84, 88, 89
POST-MORTEM APPEARANCES, in deaths from electrocution, . . . 219
    from hanging, ... 264
    from lightning, ... 220
    from strangulation, ... 229
    from submersion, ... 323, 326
    from suffocation, ... 303
POST-MORTEM BIRTH, ... 366, 613
  can fœtus live? 623
  cases illustrative of, ... 616
  causes assigned for, ... 622
POST-MORTEM ECCHYMOSES, ... 31
POST-MORTEM EXAMINATION OF INFANTS, ... 474
POWDER, SMOKELESS, ... 161

PAGE
POWDER-BRANDS, ... 155
POWDER-MARKS, ... 155, 160, 161
PREGNANCY, ... 507
  ballottement in, ... 565
  beginning of, ... 508
  bladder disturbances in, ... 556
  certain signs of, ... 572
  cessation of menstruation in, ... 557
  changes of external genitals in, ... 558
    of mammæ in, ... 568
    of portio vaginalis in, ... 561
    of skin in, ... 556
    of umbilicus in, ... 572
    of uterus in, ... 562
    of vagina in, ... 559
    of vulva in, ... 558
  diagnosis of, ... 553
    cases illustrative of, ... 576
  diminished duration of, ... 520, 523
  disputed, ... 553
  doubtful signs of, ... 554
  duration of, ... 507, 511
  enlargement of abdomen in, ... 556
  examination to determine existence of, in capital cases, . . . 499
  false, ... 578
  feigned, ... 578
    cases illustrative of, ... 580
  fœtal heart-sounds in, ... 573
  following rape, ... 689
  how soon can it occur after delivery? 600
  intermittent uterine contractions in, ... 566
  mask of, ... 556
  miscellaneous signs of, ... 576
  morning sickness in, ... 554
  movements of fœtus in, ... 574
  nervous, ... 578
  œdema in, ... 556
  pain in, ... 556
  palpation of fœtus in, ... 572
  popular signs of, ... 576
  probable signs of, ... 557
  prolonged, ... 514
    cases illustrative of, ... 515
  rectal disturbances in, ... 555
  spurious, ... 578

PREGNANCY, PAGE
striæ in, ... 572
sympathetic disturbances in, ... 555
symptoms of, ... 553
umbilical murmur in, ... 575
unconscious, ... 605
cases illustrative of, ... 606
uterine murmur in, ... 567
varicosities in, ... 556
PROJECTILE, course of, ... 163
evidence from, ... 146
PSEUDO-CYESIS, ... 578
PSYCHONEUROSES, TRAUMATIC, ... 868
PSYCHOSIS, LITIGATION, ... 871
PUBERTY, ... 645, 648, 728
PUERPERAL STATE, ... 507
disputed, ... 553
feigned, ... 578
cases illustrative of, ... 580
PUNCTURED WOUNDS, see Wounds punctured
PUTREFACTION, bacteriological appearances in, ... 442
evidence from, in infanticide, ... 416, 418
of immersed bodies, ... 332
PYÆMIA, ... 57

RAILWAY INJURIES, ... 765
accident aboulia, ... 872
attitude, study of, ... 935
autohypnosis as cause of, ... 775
back, injuries to, ... 816, 819, 820
sprains of, ... 818, 819
strains of, ... 819, 823
bi-kinesie, ... 795, 796, 882
brain, compression of, ... 847
concussion of, ... 843
bridges as cause of, ... 784
catastrophes, ... 773
causal factors of, ... 778
causes, classification of, ... 773, 795
cervical region, strains and injuries of, ... 823
classification of, ... 807
character of, ... 807
compensation, influence of, on clinical features, ... 949
concussion, of brain, ... 843
of cord, ... 825
of spine, ... 870

Railway injuries, PAGE
- conditions necessary to the safe operation of railway, . . . 778
- contractures, ... 910
- co-ordination, tests of, ... 938
- cord, concussion of, ... 825
  - lesions of, ... 831
  - traumatism of membranes of, ... 836
- curves, as cause of, ... 781
- defective motor power, as cause of, ... 792
- defects of vision, as diagnostic sign of traumatic neurosis, . . 927
- disease of employees, as cause of, ... 788
- disturbances of circulatory system, ... 901, 941
  - of digestion, ... 901, 943
  - of respiration and speech, ... 911
  - of special senses, ... 900, 940
- epilepsy, traumatic, ... 848
- examination of patient, ... 932
  - danger of long-continued and multiple, ... 934
- expert, why employed, ... 921
- face, study of, ... 935
- fracture-dislocation of spine, ... 830, 831
- fracture of vertebræ, ... 830
- gait, disturbances of, ... 935
- gradient, as cause of, ... 782
- hæmatomyelia, traumatic, ... 840
- hæmatorrhachis, ... 839
- hæmaturia, from back injuries, ... 859
  - diagnosis of, ... 860
  - general causation of, ... 860
  - producing albuminuria, ... 863
  - prognosis of, ... 861
- hemianæsthesia, ... 906
- hemorrhages, extramedullary, ... 839
- hernia, ... 853
- heterophemy, as cause of, ... 775
- history, importance of complete, ... 931
- hyperæsthesia, ... 906
- hysteria, ... 902, 912
- hysterical contractures, ... 910
  - joints, ... 910
- individual accidents, ... 773
- injuries of thorax and contents, ... 857
- insanity, traumatic, ... 850
- introductory, ... 765
- kidney, position of, a predisposing cause, ... 859
- kinetic-kinesic, ... 795, 796, 882

RAILWAY INJURIES, PAGE
- laws of liability for, 773
- litigation after, 917
  - psychosis, 871
- locomotion, impairments of, 938
- locomotor ataxia, 842
- lumbago, traumatic, 818
- lumbar sprain, 818, 821
  - strain, 819, 821
- malingering, 952
- manipulation of trains, as cause of, 788
- manner of injury to citizens, 797
  - to employees, 799
  - to passengers, 798
  - to trespassers, 797
- Mannskopf sign, 948
- mental condition of employees, as cause of, 771, 775, 776, 801
  - diseases, following, 850
- mono-kinesic, 795, 796, 883
- monoplegia, 909
- muscles of face, trembling of, 942
- natural phenomena, as causes of, 794
- negligence of employees, as cause of, 771, 788
- neurasthenia, 873, 889
- overwork of employees, as cause of, 788
- paraplegia, 909
- paralyses, motor, 908
- precedent diseases, influence of, 960
- predisposition, as a factor in psycho-neuroses, 885
- prognosis, 914, 960
- psycho-neuroses, traumatic, 868, 877, 913
  - causes of, 915
  - classification of, 882
  - factors in, 878
  - hysterical type of, 902
  - mental state in, 893
  - motor disturbances in, 896, 908
  - muscular tremors in, 897
  - neurasthenic type of, 889
  - paralysis in, 908
  - prognosis of, 960
  - reflexes in, 897
  - sensory disturbances in, 898
  - symptoms of, 892
- road-bed, as cause of, 779
- sensibility, tests of, 945

RAILWAY INJURIES, PAGE
- shock, corporeal and psychic, ... 808, 810
- simulation, frequency of, ... 923
- speech, modification of, ... 942
- spinal meningitis, infrequency of, ... 838
- statistics of, ... 769, 797, 798, 799, 800, 807, 884
- switches, as cause of, ... 783
- symptoms, study of, ... 935
- syringomyelia, traumatic, ... 841
- traumatic hysteria, ... 872
- un-kinesic, ... 795, 796, 883
- vertebræ, dislocations of, ... 828
  - distortions of, ... 828
  - fractures of, ... 830
  - traumatism of, ... 826
- why considered specially, ... 813
- why of frequent occurrence, ... 800

RAILWAY SPINE. 869

RAPE (and see Defloration, Virginity), ... 659
- absence of will in, ... 691
- accidents following, ... 689
- age of consent, ... 660, 664
- attempt at, ... 706
- by boys, ... 680, 727
- by females on females, ... 731
- by females on males, ... 729
- by fraud, ... 660, 693
- by women, ... 727, 729
- can a woman be violated against her will? 691
- can rape be accomplished during natural sleep? 692
- consent in, ... 660, 691
- death following, ... 677, 690, 716
- defence, in accusations of, ... 703
- disproportion in size of organs, in accusations of, . . . 703, 706
- during anæsthesia, ... 694
  - epilepsy, ... 696
  - sleep, ... 692
  - unconsciousness, ... 694
- errors in examinations, in cases of, ... 701
- evidence of, see Hymen, Vagina
  - after death, ... 704
  - from discharges, ... 711
    - venereal diseases, ... 683, 687, 705, 713
- examination of the accused, ... 702
  - locality of the assault, ... 703
- false accusations of, ... 661, 700, 717

PAGE

in hypnotic state, ... 696
  somnambulism, ... 698
interval between assault and examination, ... 720
law of, ... 659
locality in which committed, ... 703
marks of a struggle, ... 721
  of violence, ... 681, 715
medical examination, in cases of, ... 662
  how recorded, ... 663
on children, ... 705, 719
    diagnosis of, ... 725
    false accusations of, ... 714, 717
    intervals between assault and examination, . . . 720
    marks of a struggle, ... 721
    statistics of trials, ... 725
    study of 200 cases of, ... 719
  females after puberty, ... 665
  infants, ... 705
  married women, ... 681
  psychopathic individuals, ... 696
  the dead, ... 731, 761
penetration in, ... 710, 715
pregnancy following, ... 689
rules for examination, in cases of, ... 701
simulation of, ... 700
stains and other marks, ... 682
testimony concerning, ... 661
  corroborative, ... 661
  of woman herself, ... 661
violence, marks of, ... 681, 715
vulva, appearance of, after, ... 721
RESEMBLANCES BETWEEN PARENT AND CHILD (and see Mother's marks,
  Atavism), ... 542, 645
  cases illustrative of, ... 544
RESISTANCE, electrical, ... 189
RIBS, fracture of, ... 120
RIGOR MORTIS, in deaths from electricity, ... 218
ROENTGEN PHOTOGRAPHS AS EVIDENCE, in gunshot wounds, . . . 172
RUPTURE OF ABDOMINAL VISCERA, ... 128
  of bladder, ... 131
  of diaphragm, ... 125
  of gall bladder, ... 130
  of heart, ... 124
  of internal organs, ... 99
  of intestines, ... 132

RUPTURE OF ABDOMINAL VISCERA, PAGE
  of kidneys, ... 130
  of liver, ... 128
  of spleen, ... 130
  of stomach, ... 132

SADISM, ... 739
SAPHISM, ... 755
SATYRIASIS, ... 739
SEBACEOUS CYSTS, ... 532
SEMEN, stains of, ... 673, 682
SEPTICÆMIA, ... 56
SEXUAL FUNCTION, abolished, ... 739
  exaggerated, ... 739
  perverted, ... 731, 739
SEXUAL INCAPACITY (and see Impotence, Sterility), ... 625
  and adoption, ... 634
  artificial fecundation in, ... 629
  as it concerns the dissolution of marriage, ... 635
  disputed capacity, ... 632
    paternity, ... 632
  expert conclusions concerning, ... 655
  in criminal affairs, ... 639
  influence of hybridity, ... 646
  relevant ethical conditions, ... 629
SEXUAL INVERSION, ... 737, 739, 745, 748
  conditions affecting, ... 753
SHARK-BITES, ... 330
SHOCK, death due to, ... 45
  in railway injuries, ... 808
SHOT-GUNS, wounds by, ... 154
SKIAGRAMS, as evidence in gunshot wounds, ... 172
SKULL, fracture of, ... 105, 158
  resistance of, in the dead, ... 153
SMALL SHOT, wounds by, ... 165
SMOKELESS POWDER, marks from, ... 161
SMOTHERING, ... 296
SODOMY, ... 744
SPERMATOZOA, ... 682
  movements of, ... 510
  vitality of, ... 509, 510
SPINAL CORD, concussion of, ... 119, 825
  lesions of, ... 831
  wounds of, ... 117
SPINE, concussion of, ... 870
  contusions of, ... 829

PAGE

Spine,
  dislocation of, ... 118
  fracture of, ... 117
  fracture dislocation of, ... 830, 831
  traumatisms of, ... 826
  wounds of, ... 117
Spleen, rupture of, ... 130
  wounds of, ... 130
Stab wounds (and see Wounds, punctured), ... 9, 65
Staining of skin, by lightning, ... 213
Stains, could assailant have escaped without? 84
  in cases of rape, ... 682
  of meconium, ... 442
  on murderer, ... 84
  seminal, ... 673, 682
Starvation, survivorship in cases of death by, ... 346
Sterility, ... 627
  causes of, ... 644
  from congenital and other defects, ... 650
  in women, ... 648
  meteorological influences, ... 646
  pathological conditions of, ... 651
  relative, ... 638
Sternum, fracture of, ... 120
Still-birth, ... 416
Stomach, rupture of, ... 132
  wounds of, ... 132
Strangulation, ... 223, 224
  accidental, ... 241
    cases of, ... 251
  ante-mortem or post-mortem, ... 267
  cases of, ... 243
  external appearances due to, ... 229
  homicidal, ... 242
    cases of, ... 243
  internal appearances due to, ... 234
  post-mortem appearances, ... 229, 234
  prognosis, ... 229
  proof of death by, ... 238
  simulated, ... 242
  stages of, ... 226
  suicidal, ... 241
    cases of, ... 249
  symptoms of, ... 224, 226
  treatment of, ... 228
Struggle, signs of, ... 82

PAGE
SUBMERSION, ... 317
 asphyxia by, ... 318, 319
 cadaveric signs in death by, ... 326
 circumstances modifying time of, ... 332
 definition of, ... 318
 mode of death by, ... 319
 post-mortem appearances, ... 323, 326
 stages and symptoms of death by, ... 320
 survivorship in cases of death by, ... 344
 treatment of apparently drowned, ... 324
 whether accidental, suicidal, or homicidal, ... 329
SUFFOCATION, ... 223, 296
 accidental, ... 307
  cases of, ... 309
 by submersion, ... 318
 cases of, ... 309
 cause of death in, ... 299
 death of infant from, ... 458
 external, causes of, ... 296
 homicidal, ... 307
  cases of, ... 312
 internal causes of, ... 297
 mechanical, ... 223
 of infants, ... 458
 post-mortem appearances, ... 303
  in infants, ... 461
 proof of death by, ... 306
 suicidal, ... 307
  cases of, ... 312
 survivorship in cases of death by, ... 345
 symptoms of, ... 299
 treatment of, ... 301
SUPERFECUNDATION, ... 596
SUPERFŒTATION, ... 596
 cases illustrative of, ... 600
SUPERIMPREGNATION, ... 596
SURGICAL OPERATIONS, death from, ... 61, 173
SURVIVAL, ... 102
SURVIVORSHIP, ... 337
 determination of, ... 337, 342
  from position, ... 349
  from stage of putrefaction, ... 349
 determination of time of death, ... 350
 expert medical testimony in, ... 340
 influence of age, ... 343

Survivorship, influence, PAGE
 of constitution, . . . 343
 of degree of danger, . . . 342
 of mode of death, . . . 344
  asphyxia, . . . 346
  cold, . . . 347
  drowning, . . . 344
  electricity, including lightning, . . . 348
  heat, . . . 347
  parturition, . . . 348, 454
  poisoning, . . . 348
  starvation, . . . 346
  suffocation, . . . 345
 of sex, . . . 343
 legal presumption of, . . . 337
 medical aspects of, . . . 342
 of persons who have disappeared, . . . 341
Syncope, . . . 225, 318, 321
Syphilis, . . . 687, 705, 713, 729, 750
Syringomyelia, traumatic, . . . 841

Tetanus, . . . 59
Thorax, injuries to, . . . 857
 wounds of, . . . 119
Throat, incised wound of, . . . 72
Throwing back, . . . 644
Tribadism, . . . 731, 737, 740, 755, 760

Umbilical cord, see Abortion, Infanticide
Unborn child, killing of, . . . 411
Unconscious delivery, . . . 608
 impregnation, . . . 602
 pregnancy, . . . 605
Unnatural crimes, . . . 737
 examination of persons charged with, . . . 757
Uranism, . . . 739
Utero-gestation, see Pregnancy
Uterus, changes of, in pregnancy, . . . 562
 injuries to, in abortion, . . . 390
 rupture of, . . . 390
 sounds heard in connection with, in pregnancy, . . . 575

Vagina, changes in, in pregnancy . . . 559
 discharges from, . . . 683
 in children, . . . 708
  after rape, . . . 724

	PAGE
VAGINA,	
in virgins,	675
secretions of,	724
VEINS, air in,	125
wounds of,	124
VERNIX CASEOSA,	531, 532
VERTEBRÆ, dislocations of,	828
distortions of,	828
fractures of,	830
traumatism of,	826
VIABILITY,	421, 520, 522, 523
cases of early,	541
of children born before term,	522
VIOLATION,	706
VIRGINITY, see Defloration	
condition of mammæ,	675
is an intact hymen evidence of?	672
signs of,	666
simulation of,	675
VULVA, appearance of,	666
changes of, in pregnancy,	558
in children,	707
after rape,	708, 721
WEAPONS,	70
evidence from,	146
as to origin of wounds,	79, 95
examination of,	159
presence of blood and hair on,	81
was it fired from a distance or near?	160
which of two caused certain wounds?	70
WOUNDS,	3
ante-mortem, signs of,	29
as direct cause of death,	43
as secondary cause of death,	55
by what instrument made?	63, 70
cause of death from,	42, 43, 49
coagulation of blood in,	34
consequences of non-fatal,	102
contused,	13, 16, 69
death from, after long periods,	54
definitions of,	5
description of,	28
direction of,	75
eversion of lips of,	35
evidence from weapon,	79, 95, 146

WOUNDS. PAGE
- examination of, . . . 22
  - of clothes and body of accused, . . . 83
- fatal, acts performed after, . . . 39
- from crushing, . . . 99
  - falling, . . . 95, 98
  - lightning, . . . 212
- gunshot, . . . 139
  - accidental, . . . 166
  - by blank charges, . . . 166
  - by infected bullets, . . . 169
  - by shot-guns, . . . 154
  - by small shot, . . . 165
  - complications of, . . . 173
  - course of projectile, . . . 163
  - death from surgical operations in, . . . 173
  - description of, . . . 140
  - dimensions of perforations, . . . 157
  - direction of, . . . 145
  - examination of, . . . 140
    - of body in, . . . 158
    - of weapon in, . . . 159
  - fracture caused by, . . . 144
  - infection from, . . . 170
  - of entrance, . . . 162
  - of exit, . . . 162
  - Roentgen rays as evidence of, . . . 172
  - situation of, . . . 144
  - treatment of, . . . 168
  - whether suicidal, . . . 144
- hemorrhage from, . . . 29
- imputed, . . . 90
- incised, . . . 6, 63, 103
  - diagnosis of, . . . 8
  - prognosis of, . . . 9
- kinds of, . . . 5
- lacerated, . . . 17, 69
- mortal, . . . 6
- nature of, . . . 72
- number and extent of, . . . 77
- of abdominal viscera, . . . 126, 128
    - wall, . . . 126
  - arteries and veins, . . . 124
  - bladder, . . . 131
  - brain, . . . 115
  - diaphragm, . . . 125

Wounds of PAGE
- extremities, ... 135
- face, ... 115
- gall-bladder, ... 130
- genital organs, ... 134
- head, ... 103, 104
- heart, ... 121
- intestines, ... 132
- kidneys, ... 130
- liver, ... 128
- lungs, ... 121
- neck, ... 115
- spinal cord, ... 117
- spine, ... 117
- spleen, ... 130
- stomach, ... 132
- thoracic viscera, ... 119
- thorax, ... 119
- throat, incised, ... 72

origin of, evidence from weapons, ... 79, 95
post-mortem, signs of, ... 37
punctured, ... 9, 64, 103
regionally considered, ... 103
retraction of sides of, ... 36
severe, ... 6
situation and position of, ... 73, 94
slight, ... 6
whether accidental, ... 93
- ante-mortem or post-mortem, ... 28, 36, 37
- made by instrument described, ... 63
- necessarily the cause of death, ... 46
- self-inflicted or by another, ... 71, 90, 94

which of several was first inflicted? 100
- of two or more was cause of death? 46

LAW LIBRARY
OF
LOS ANGELES COUNTY

LAW LIBRARY
UNIVERSITY OF CALIFORNIA
LOS ANGELES

UC SOUTHERN REGIONAL LIBRARY FACILITY

AA 000 854 763 0

LAW LIBRARY
OF
LOS ANGELES COUNTY